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# MACHINERY'S DATA SHEETS

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## No. 12

# Pipe and Pipe Fittings

PRICE 25 CENTS

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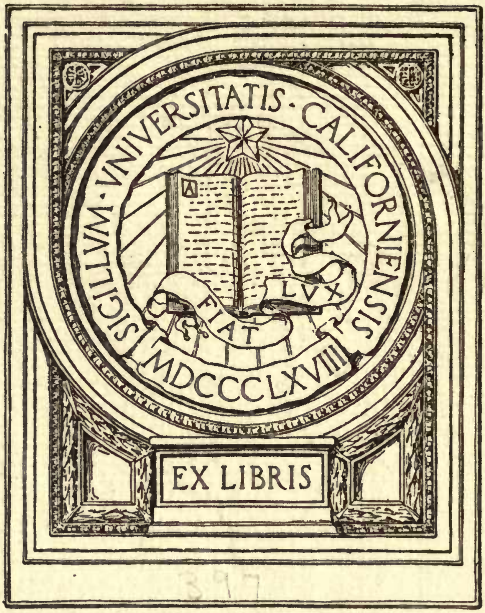

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# MACHINERY'S DATA SHEET SERIES

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SHEETS AND ARRANGED WITH
EXPLANATORY MATTER

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In the following pages are compiled a number of concise tables relating to piping and pipe fittings, carefully selected from MACHINERY's monthly Data Sheets, issued as supplements to the Engineering and Railway editions of MACHINERY since September, 1898. A number of additional tables and diagrams also are included which are published here for the first time.

In order to enhance the value of the tables, brief explanatory notes have been provided wherever necessary. In these notes references are made to articles which have appeared in MACHINERY, giving additional information on the subject. These references will be of considerable value to readers who wish to make a more thorough study of the subject. In a note at the foot of the tables, reference is made to the page on which the explanatory note relating to the table appears.

# PIPE AND PIPE FITTINGS

### Briggs Standard Pipe Thread and Gage Dimensions

Standard pipe dimensions, together with dimensions of pipe threads and gages, according to the Briggs standard are given on page 4. The Briggs standard pipe thread is made with an angle of 60 degrees and slightly rounded off at top and bottom. Taps for cutting Briggs standard pipe threads are provided with a taper of 3/4 inch per foot on the diameter. [MACHINERY, February, 1908, Screw Thread Systems; MACHINERY'S Reference Series No. 31, Screw Thread Tools and Gages, Chapter I.]

### Whitworth Thread for Gas and Water Piping

Dimensions and numbers of threads per inch for gas, water and hydraulic piping, according to the Whitworth screw thread system for this class of work, are given on page 5. The form of the thread is the regular Whitworth standard form, and the only difference from the regular Whitworth standard is the number of threads per inch. The table given on page 5 also gives the permissible pressure in pounds per square inch of pipe used for hydraulic piping. [MACHINERY, February, 1908, Screw Thread Systems; MACHINERY'S Reference Series No. 31, Screw Thread Tools and Gages, Chapter I.]

### Pipe and Pipe Fittings

The results of a number of tests on piping conducted by the Crane Co. of Chicago, Ill., were presented by Mr. J. B. Berryman, before the Engine Builders' Association at the May, 1902, meeting.

Tests on pipe taken at random out of stock gave the following results: 8-inch pipe stood 2000 pounds pressure; 10-inch pipe, 2300 pounds; 12-inch pipe, 1500 pounds; 16-inch pipe, 3/8 inch thick, 800 pounds; and 24-inch pipe, 3/8 inch thick, 600 pounds per square inch, without rupture or distortion. Thousands of pieces of standard 20-inch pipe and under have stood 800 pounds pressure per square inch; hence, there is no reason why piping heavier than standard should be used in power plants, except where there is especial likelihood of corrosion.

### Flanged Joints

Most of the orders of the Crane Co. are for screwed or shrunk flanges, in the ratio of 85 screwed to 15 shrunk. The screwed joint is preferred, and the following lengths of thread are used, those given in the first column under thread lengths being for pressures up to 125 pounds, and those in the second column for pressures up to 250 pounds.

| Diameter of Pipe, Inches | Thread Lengths | |
|---|---|---|
| | 125 Pounds | 250 Pounds |
| 4 | 1 3/16 | 1 3/4 |
| 6 | 1 7/16 | 2 |
| 8 | 1 5/8 | 2 1/16 |
| 12 | 2 1/16 | 2 9/16 |
| 16 | 2 7/16 | 2 7/8 |
| 20 | 2 3/4 | 3 1/4 |

Assuming a shearing strength of one-half of the tensile strength, the above proportions give a holding power of fully three times the ultimate strength of the pipe. Joints have been tested, starting with long threads on the pipe, according to the table given, and gradually cutting away the threads. In no case were the threads stripped, and the results indicated that the strength of the joints was limited by the strength of the cast-iron flanges. On a 10-inch pipe the threads were reduced until only five threads remained. The flanges

(Continued on page 6.)

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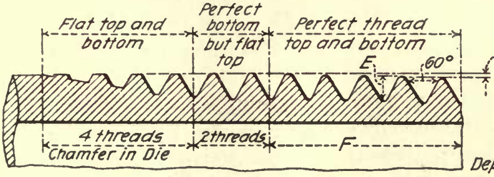
## BRIGGS PIPE THREAD AND GAGE DIMENSIONS

| Diam. of Pipe | | | Number of threads per inch | Diameter at end of pipe | Diameter at bottom of thread | Depth of thread | Length of perfect thread | Number of perfect threads | Total length of thread | No. turns pipe screws into fitting by hand | Distance pipe screws into fitting by hand | Number of turns made with wrench | Distance pipe is screwed in with wrench | Total No. of turns pipe screws into fitting | Total distance pipe screws into fitting | Diameter drill to be used with pipe reamer | Diameter of reamer at large end of reamed hole | Length of thread on plug and ring gage | Number of threads on plug and ring gage | Diameter of end of plug for testing fittings | Distance inspection plug projects through ring |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Inside | Actual Inside | Actual Outside | | | | | | | | | | | | | | | | | | | |
| | A | B | | C | D | E | F | | G | | | | | | H | | K | L | | M | N |
| 1/8 | 0.270 | 0.405 | 27 | 0.398 | 0.334 | 0.029 | 0.19 | 5.13 | 0.412 | 4 | 0.148 | 1.13 | 0.042 | 5.13 | 0.19 | 21/64 | 0.347 | 0.264 | 7.13 | 0.386 | 0.116 |
| 1/4 | 0.364 | 0.540 | 18 | 0.522 | 0.433 | 0.044 | 0.29 | 5.22 | 0.624 | 4 | 0.222 | 1.22 | 0.068 | 5.22 | 0.29 | 29/64 | 0.448 | 0.401 | 7.22 | 0.511 | 0.179 |
| 3/8 | 0.494 | 0.675 | 18 | 0.656 | 0.568 | 0.044 | 0.30 | 5.40 | 0.634 | 4 | 0.222 | 1 40 | 0.078 | 5.40 | 0.30 | 19/32 | 0.583 | 0.411 | 7.40 | 0.644 | 0.189 |
| 1/2 | 0.623 | 0.840 | 14 | 0.815 | 0.701 | 0.057 | 0.39 | 5.46 | 0.818 | 4 | 0.285 | 1.46 | 0.105 | 5.46 | 0.39 | 23/32 | 0.719 | 0.533 | 7.46 | 0.800 | 0.247 |
| 3/4 | 0.824 | 1.050 | 14 | 1.025 | 0.911 | 0.057 | 0.40 | 5.60 | 0.828 | 4 | 0.285 | 1.60 | 0.115 | 5.60 | 0.40 | 15/16 | 0.929 | 0.543 | 7.60 | 1.009 | 0.257 |
| 1 | 1.048 | 1.315 | 11 1/2 | 1.283 | 1.144 | 0.069 | 0.51 | 5.87 | 1.03 | 4 1/2 | 0.391 | 1.37 | 0.119 | 5.87 | 0.51 | 1 3/16 | 1.170 | 0.684 | 7.87 | 1.265 | 0.293 |
| 1 1/4 | 1.380 | 1.660 | 11 1/2 | 1.626 | 1.488 | 0.069 | 0.54 | 6.21 | 1.06 | 5 | 0.435 | 1.21 | 0.105 | 6.21 | 0.54 | 1 15/32 | 1 515 | 0.714 | 8.21 | 1.608 | 0.279 |
| 1 1/2 | 1.610 | 1.900 | 11 1/2 | 1.866 | 1.728 | 0.069 | 0.55 | 6.33 | 1.07 | 5 | 0.435 | 1.33 | 0.115 | 6.33 | 0.55 | 1 23/32 | 1.757 | 0.724 | 8.33 | 1.848 | 0.289 |
| 2 | 2.067 | 2.375 | 11 1/2 | 2.339 | 2.201 | 0.069 | 0.58 | 6.67 | 1.10 | 5 | 0.435 | 1.67 | 0.145 | 6.67 | 0.58 | 2 3/16 | 2.228 | 0.754 | 8.67 | 2 319 | 0.319 |
| 2 1/2 | 2.468 | 2.875 | 8 | 2.819 | 2.619 | 0.100 | 0.89 | 7.12 | 1.64 | 5 | 0.625 | 2.12 | 0.265 | 7.12 | 0.89 | 2 11/16 | 2.655 | 1.14 | 9.12 | 2.787 | 0.515 |
| 3 | 3.067 | 3.500 | 8 | 3.441 | 3.241 | 0.100 | 0.95 | 7.60 | 1.70 | 5 | 0.625 | 2.60 | 0.325 | 7.60 | 0.95 | 3 5/16 | 3.279 | 1.20 | 9.60 | 3.405 | 0.575 |
| 3 1/2 | 3.548 | 4.000 | 8 | 3.938 | 3.738 | 0 100 | 1.00 | 8.00 | 1.75 | 5 | 0.625 | 3.00 | 0.375 | 8.00 | 1.00 | 3 13/16 | 3.776 | 1.25 | 10.00 | 3.899 | 0.625 |
| 4 | 4.026 | 4.500 | 8 | 4.434 | 4.234 | 0.100 | 1.05 | 8.40 | 1.80 | 5 1/2 | 0.688 | 2.70 | 0.362 | 8.40 | 1.05 | | 4.277 | 1.30 | 10.40 | 4.396 | 0.612 |
| 4 1/2 | 4.508 | 5.000 | 8 | 4.931 | 4.731 | 0.100 | 1.10 | 8.80 | 1.85 | 5 1/2 | 0.688 | 3.30 | 0.412 | 8.80 | 1.10 | | 4.774 | 1.35 | 10.80 | 4.890 | 0.662 |
| 5 | 5.045 | 5.563 | 8 | 5.490 | 5.290 | 0.100 | 1.16 | 9.28 | 1.91 | 5 1/2 | 0.688 | 3.78 | 0.472 | 9.28 | 1.16 | | 5.333 | 1.41 | 11.28 | 5.445 | 0.722 |
| 6 | 6.065 | 6.625 | 8 | 6.546 | 6.346 | 0.100 | 1.26 | 10.08 | 2.01 | 6 | 0.750 | 4.08 | 0.510 | 10.08 | 1.26 | | 6.393 | 1.51 | 12.08 | 6.499 | 0.760 |
| 7 | 7.023 | 7.625 | 8 | 7.540 | 7.340 | 0.100 | 1.36 | 10.88 | 2.11 | 7 | 0.875 | 3.88 | 0.485 | 10.88 | 1.36 | | 7.395 | 1.61 | 12.88 | 7.494 | 0.735 |
| 8 | 7.982 | 8.625 | 8 | 8.534 | 8.334 | 0.100 | 1.46 | 11.68 | 2.21 | 8 | 1.000 | 3.68 | 0.460 | 11.68 | 1.46 | | 8.391 | 1.71 | 13.68 | 8.490 | 0.710 |
| 9 | 8.937 | 9.625 | 8 | 9.527 | 9.327 | 0.100 | 1.57 | 12.56 | 2.32 | 9 | 1.125 | 3.56 | 0.445 | 12.56 | 1.57 | | 9.398 | 1.82 | 14.56 | 9.484 | 0.695 |
| 10 | 10.019 | 10.750 | 8 | 10.645 | 10.445 | 0.100 | 1.68 | 13.44 | 2.43 | 10 | 1.250 | 3.44 | 0.430 | 13.44 | 1.68 | | 10.524 | 1.93 | 15.44 | 10.603 | 0.680 |



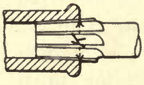
$\frac{1}{32}$ inch in 1 inch length

Taper of Pipe End
$\frac{3}{4}$ inch per foot, $\frac{1}{16}$ inch per inch.

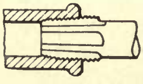
Depth of Thread (E) = $\frac{0.8}{\text{Threads per inch}}$

Pipe Thread (Enlarged)

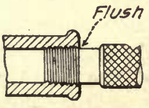
Note:- The pipe should always be cut to fit Briggs standard pipe gage.
In theory the joint should be tight when pipe has entered fitting a distance equal to H, but to allow for errors, the thread on pipe is cut two threads farther than H. The fitting should be tapped two threads deeper than H for the same reason.



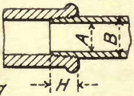
Reamer.



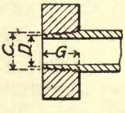
Tap.



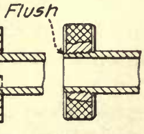
Plug for Testing Fittings.



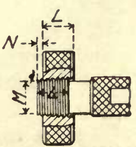
Joint.



Die.



Standard Ring Gage.



Standard Ring Gage and Plug for Testing Fittings.

Contributed by Patrick Burke, MACHINERY'S Data Sheet No. 78. Explanatory notes: Pages 3 and 7.

## WHITWORTH'S SCREW THREADS FOR GAS, WATER AND HYDRAULIC IRON PIPING.

### GAS AND WATER PIPING.

| Diameter of Piping | | Diameter at Bottom of Thread. | No. of Threads per Inch. |
|---|---|---|---|
| Internal. | External. | | |
| ⅛ | .3825 | .3367 | 28 |
| ¼ | .518 | .4506 | 19 |
| ⅜ | .6563 | .5889 | 19 |
| ½ | .8257 | .7342 | 14 |
| ⅝ | .9022 | .8107 | 14 |
| ¾ | 1·041 | .9495 | 14 |
| ⅞ | 1.189 | 1.0975 | 14 |
| 1 | 1.309 | 1.1925 | 11 |
| 1⅛ | 1.492 | 1.3755 | |
| 1¼ | 1.650 | 1.5335 | |
| 1⅜ | 1.745 | 1.6285 | |
| 1½ | 1.8825 | 1.7660 | |
| 1⅝ | 2 021 | 1.9045 | |
| 1¾ | 2.047 | 1.9305 | |
| 1⅞ | 2.245 | 2.1285 | |
| 2 | 2.347 | 2.2305 | |
| 2⅛ | 2.467 | 2.3505 | |
| 2¼ | 2.5875 | 2.4710 | |
| 2⅜ | 2.794 | 2.6775 | |
| 2½ | 3.0013 | 2.8848 | |
| 2⅝ | 3.124 | 3.0075 | |
| 2¾ | 3.247 | 3.1305 | |
| 2⅞ | 3.367 | 3.2505 | |
| 3 | 3.485 | 3.3685 | |
| 3¼ | 3.6985 | 3.5820 | |
| 3½ | 3.912 | 3.7955 | |
| 3¾ | 4.1255 | 4.0090 | |
| 4 | 4.339 | 4.2225 | |

### HYDRAULIC PIPING.

| Diameter of Piping | | Diameter at Bottom of Thread. | Pressure in lbs. per square Inch. | No. of Threads per Inch. |
|---|---|---|---|---|
| Internal. | External | | | |
| ¼ | ⅝ | .5335 | 4000 | 14 |
| | ¾ | .6585 | 6000 | |
| | ⅞ | .7835 | 8000 | |
| | 1 | .9085 | 10000 | |
| ⅜ | ¾ | .6585 | 4000 | 14 |
| | ⅞ | .7835 | 6000 | |
| | 1 | .9085 | 8000 | |
| | 1⅛ | 1.0335 | 10000 | |
| ½ | 1 | .9085 | 4000 | 14 |
| | 1⅛ | 1.0335 | 6000 | |
| | 1¼ | 1.1335 | 8000 | 11 |
| | 1⅜ | 1.2585 | 10000 | |
| ⅝ | 1⅛ | 1.0335 | 4000 | 14 |
| | 1¼ | 1.1335 | 6000 | 11 |
| | 1⅜ | 1.2585 | 8000 | |
| | 1½ | 1.3835 | 10000 | |
| ¾ | 1¼ | 1.1335 | 4000 | 11 |
| | 1⅜ | 1.2585 | 6000 | |
| | 1½ | 1.3835 | 8000 | |
| | 1⅝ | 1.5085 | 10000 | |
| ⅞ | 1⅜ | 1.2585 | 4000 | 11 |
| | 1½ | 1.3835 | 6000 | |
| | 1⅝ | 1.5085 | 8000 | |
| | 1¾ | 1.6335 | 10000 | |
| 1 | 1½ | 1.3835 | 4000 | 11 |
| | 1⅝ | 1.5085 | 6000 | |
| | 1¾ | 1.6335 | 8000 | |
| | 1⅞ | 1.7585 | 10000 | |
| 1⅛ | 1⅝ | 1.5085 | 4000 | 11 |
| | 1¾ | 1.6335 | 6000 | |
| 1⅛ | 1⅞ | 1.7585 | 8000 | 11 |
| | 2 | 1.8835 | 10000 | |
| 1¼ | 1¾ | 1.6335 | 4000 | 11 |
| | 1⅞ | 1.7585 | 6000 | |
| | 2 | 1.8835 | 8000 | |
| | 2⅛ | 2.0085 | 10000 | |
| 1⅜ | 1⅞ | 1.7585 | 4000 | 11 |
| | 2 | 1.8835 | 6000 | |
| | 2⅛ | 2.0085 | 6000 | |
| | 2¼ | 2.1335 | 10000 | |
| 1½ | 2 | 1.8835 | 4000 | 11 |
| | 2⅛ | 2.0085 | 6000 | |
| | 2¼ | 2.1335 | 8000 | |
| | 2⅜ | 2.2585 | 10000 | |
| | 2½ | 2.3835 | 10000 | |
| 1⅝ | 2⅛ | 2.0085 | 4000 | 11 |
| | 2¼ | 2.1335 | 6000 | |
| | 2⅜ | 2.2585 | 8000 | |
| | 2½ | 2.3835 | 10000 | |
| 1¾ | 2¼ | 2.1335 | 3000 | 11 |
| | 2⅜ | 2.2585 | 4000 | |
| | 2½ | 2.3835 | 6000 | |
| | 2¾ | 2.6335 | 10000 | |
| 1⅞ | 2⅜ | 2.2585 | 3000 | 11 |
| | 2½ | 2.3835 | 4000 | |
| | 2¾ | 2.6335 | 8000 | |
| 2 | 2½ | 2.3835 | 3000 | 11 |
| | 2¾ | 2.6335 | 6000 | |
| | 3 | 2.8835 | 10000 | |

MACHINERY'S Data Sheet No. 13. Explanatory notes: Pages 3 and 7.

broke at 650 pounds pressure per square inch, but all the threads remained intact.

A great number of tests have also been made by the Crane Co. on 8-inch pipe, using regular wrought-iron couplings to demonstrate that long threads are not necessary for strength. In these tests barely 6 threads were in contact in the final tests, the length of the threaded part being only 3/4 inch. The pipe was tested at a pressure of 1000 pounds per square inch, the pressure being held for a whole day without the threads giving way. The only object in using a long threaded portion is to make a tight joint. The pipe should be screwed clear through the flange, to guard against vibration, and should make a bearing for the gasket on the end of the pipe. The flange should be screwed on until the pipe projects 1/16 inch. Then the end of the pipe should be faced off, true with the axis of the pipe. In making shrunk joints, the pipe is trued up and calipered, the flange bored out to a shrinking-fit size, brought to a red heat, and then the pipe slipped in and peened over.

Flanges are generally made with straight face finished smooth, with straight face corrugated, with tongue and groove, or with a face raised 1/32 inch inside of the bolt holes. For pressures of 180 pounds or less, the experiments of the Crane Co. show that the straight concentrically corrugated face will hold a Rainbow or copper gasket. Repeated tests have been made with pressures up to 1000 pounds per square inch without blowing out the gasket.

There are two recognized standards for flanges. The one for pressures up to 125 pounds per square inch was adopted by a joint committee of the American Society of Mechanical Engineers, the Master Steam Fitters' Association, and the pipe fittings manufacturers; the other, for pressures up to 250 pounds per square inch, was adopted at a meeting of the pipe fittings manufacturers, held in New York, June 28, 1901, and is generally referred to as the "Manufacturers standard."

### Flanged Fittings

Flanged fittings are manufactured in three weights for pressures up to 50, 125 and 250 pounds per square inch, respectively. The thickness of the body metal of each is as follows:

| Diameter of Pipe, Inches | Light | Standard | Extra Heavy |
|---|---|---|---|
| 6 |  | 9/16 | 3/4 |
| 10 |  | 3/4 | 15/16 |
| 12 | 1/2 | 13/16 | 1 |
| 16 | 5/8 | 1 | 1 3/16 |
| 20 | 11/16 | 1 1/8 | 1 5/16 |
| 24 | 3/4 | 1 1/4 | 1 1/2 |

These thicknesses give factors of safety of from 10 to 12, as computed by the ordinary formula for the strength of piping. A high factor of safety is desirable, since tests show that fittings burst at a pressure less than that indicated by the formula.

### Valves

Valves are made of the same thickness as flanged fittings, and are designed for corresponding pressures. Standard valves, 4 inches to 8 inches, will burst at about 700 pounds, and valves 10 inches to 16 inches at about 600 pounds per square inch. Extra heavy valves, 4 inches to 8 inches, burst at 1600 to 1900 pounds, and 10 inches to 16 inches at about 1200 to 1500 pounds per square inch. A medium valve is made for pressures between those for which the standard and extra heavy valves are designed. The valve subjected to the tests mentioned were of the solid wedge type, and it was found that their disks would stand about 80 per cent of the bursting pressure without leaking. It is not considered desirable to rib the bodies of heavy valves, owing to the resulting unequal strains. For high pressures, valves without outside screw and yoke should be used.

### Pipe Bends

Unless pipe bends are of very short radius they are generally made of standard pipe for pressures up to 125 pounds per square inch; of full weight pipe for pressures between 125 and 175 pounds; and of extra heavy pipe for higher pressures.

### Dimensions of Standard Wrought-iron Pipe

On pages 8 and 9 are given all the ordinarily required dimensions for standard wrought-iron pipe. Two columns of dimensions are given for the actual outside diameter, the one giving the diameter exact in decimals of an inch, and the other giving the diameter in common fractions, and expressed in the manner usually employed by pipe fitters. On pages 10 and 11 are given the main dimensions for standard, extra strong, and double extra strong pipe. In these tables the moment of inertia, section modulus, radius of gyration, etc., of the pipe section, are also given. These data will prove useful in the calculations required when pipe is used in structural design, as for girders or columns. On page 12 are given the standard dimensions for Shelby cold drawn mechanical tubing. The body of the table gives the inside diameter in inches, and the left-hand column the outside diameter. On page 13, the body of the table gives the weight in pounds per lineal foot of Shelby cold drawn tubing. For example, what is the weight per foot of Shelby tubing 2 inches outside diameter, 1 1/2 inch inside diameter? The thickness of wall in this case is 1/4 inch, and from the table we find that the weight per foot is 4.67 pounds.

### Standard Dimensions of Water Piping

On pages 14, 15 and 16 are given the standard dimensions of pipe adopted by the American Water Works Association. The tables on pages 14 and 15 are for ordinary service, while the table on page 16 is for high-pressure service. These tables are reproduced directly from the publications of the American Water Works Association. On pages 18 and 19 are given the thickness and weight of cast-iron pipe, the table on page 18 being for ordinary service pipe, and that on page 19 for fire lines and other high-pressure service. These tables are also for the standard pipe approved by the American Water Works Association.

### Cast-iron Fittings for Wrought-iron Pipe

On pages 20 to 23 are given dimensions of cast-iron fittings for wrought-iron pipe to withstand 100 and 200 pounds pressure per square inch respectively. Pipe fittings, in practice, are not proportioned on purely theoretical grounds, but a great many commercial considerations have entered in their design, the ordinary commercial test of merit of a pipe fitting being its weight. In theory the pipe fitting should be strong enough to resist the internal pressure to which it may be subjected by the fluid it is to convey, as well as the stress to which it may be subjected by the pipe fitter in "making up." The fittings now on the market, while not designed along theoretical lines, have nevertheless proved themselves able to resist the internal pressures for which they are intended.

On page 23 are given dimensions for pipe flanges for wrought-iron pipe, this table being made up for pressures up to 250 pounds per square inch.

On pages 24 to 27, inclusive, are given dimensions for cast-iron flanged fittings adapted to withstand pressures of 50, 100 and 200 pounds per square inch, respectively. On page 24 the formulas by means of which the tabulated dimensions have been determined are given. On pages 28 to 31 are given dimensions for bronze fittings adapted to withstand pressures of 70, 125 and 250 pounds

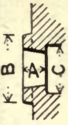
(Continued on page 17.)

## DIMENSIONS OF STANDARD WROUGHT-IRON PIPE—I

| Nominal Inside Diameter. | Actual Inside Diameter. | Actual Outside Diameter. | | Thickness. | Number of Threads per Inch. | Diameter at Bottom of Thread at End of Pipe. | Size of Drill. | Length of Perfect Thread | Diameter at Top of Thread at End of Pipe. | Internal Diameter. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/8" | .269" | .405 | 3/8" + 1/32" | .068 | 27 | 334 | 21/64" | .19 | .393 | .27 |
| 1/4" | .364" | .54 | 1/2" + 1/32" | .088 | 18 | .433 | 7/16" | .29 | .522 | .36 |
| 3/8" | 493" | 675 | 11/16" | .091 | 18 | 567 | 9/16" | .3 | .658 | 49 |
| 1/2" | 622" | .84 | 13/16" + 1/32" | .109 | 14 | 701 | 11/16" | .39 | .815 | .62 |
| 3/4" | .824" | 1.05 | 1 1/16" | .113 | 14 | .911 | 29/32" | .4 | 1.025 | .82 |
| 1" | 1.047" | 1.315 | 1 5/16" | .134 | 11 1/2 | 1.144 | 1 5/32" | .51 | 1.283 | 1.05 |
| 1 1/4" | 1.38" | 1.66 | 1 11/16" | .140 | 11 1/2 | 1.488 | 1 15/32" | .54 | 1.627 | 1.38 |
| 1 1/2" | 1.61" | 1.90 | 1 15/16" | .145 | 11 1/2 | 1.727 | 1 23/32" | .55 | 1.866 | 1.61 |
| 2" | 2.067" | 2.375 | 2 3/8" | .154 | 11 1/2 | 2.2 | 2 7/32" | .58 | 2.339 | 2.07 |
| 2 1/2" | 2.467" | 2.875 | 2 7/8" | .204 | 8 | 2.62 | 2 5/8" | .89 | 2.82 | 2.47 |
| 3" | 3.066" | 3.50 | 3 1/2" | .217 | 8 | 3.24 | 3 1/4" | .95 | 3.441 | 3.07 |
| 3 1/2" | 3.548" | 4.00 | 4" | .226 | 8 | 3.738 | 3 23/32" | 1. | 3.938 | 3.55 |
| 4" | 4.026" | 4.50 | 4 1/2" | 237 | 8 | 4.233 | 4 1/4" | 1.05 | 4.434 | 4.07 |
| 4 1/2" | 4.508" | 5.00 | 5" | .246 | 8 | 4.733 | 4 3/4" | 1.1 | 4.931 | 4.51 |
| 5" | 5.045" | 5.563 | 5 9/16" | .259 | 8 | 5.289 | 5 9/32" | 1.16 | 5.489 | 5.04 |
| 6" | 6.065" | 6.625 | 6 5/8" | .280 | 8 | 6.347 | 6 11/32" | 1.26 | 6.547 | 6.06 |
| 7" | 7.023" | 7.625 | 7 5/8" | .301 | 8 | 7.34 | 7 11/32" | 1.36 | 7.54 | 7.02 |
| 8" | 7.981" | 8.625 | 8 5/8" | .322 | 8 | 8.332 | 8 11/32" | 1.46 | 8.534 | 7.98 |
| 9" | 8.937" | 9.625 | 9 5/8" | .344 | 8 | 9.324 | 9 3/8" | 1.56 | 9.527 | 8.93 |
| 10" | 10.018" | 10.75 | 10 3/4" | .366 | 8 | 10.445 | 10 7/16" | 1.68 | 10.645 | 10.02 |
| 11" | 11" | 11.75 | 11 3/4" | .375 | 8 | 11.439 | 11 7/16" | 1.80 | 11.639 | 11 |
| 12" | 12" | 12.75 | 12 3/4" | .375 | 8 | 12.433 | 12 27/64" | 1.90 | 12.633 | 12. |
| 13" | 13.25" | 14 | 14" | .375 | 8 | 13.675 | 13 43/64" | 1.98 | 13.875 | 13.25 |
| 14" | 14.25" | 15 | 15" | .375 | 8 | 14.668 | 14 21/32" | 2.15 | 14.869 | 14.25 |
| 15" | 15.25" | 16 | 16" | .375 | 8 | 15.662 | 15 21/32" | 2.21 | 15.863 | 15.25 |
| 16" | 16.25" | 17 | 17" | .375 | 8 | 16.656 | 16 21/32" | 2.30 | 16.856 | 16.25 |
| 17" | 17.25" | 18 | 18" | 375 | 8 | 17.65 | 17 21/32" | 2.40 | 17.85 | 17.25 |
| 18" | 18.25" | 19 | 19" | .375 | 8 | 18.644 | 18 41/64" | 2.50 | 18.844 | 18.25 |
| 19" | 19.25" | 20 | 20" | .375 | 8 | 19.637 | 19 5/8" | 2.59 | 19.837 | 19.25 |
| 20" | 20.25" | 21 | 21" | 375 | 8 | 20.631 | 20 5/8" | 2.72 | 20.831 | 20.25 |
| | | *Taper of Conical Tube Ends 3/4" in Diam. in 12"* | | | | | | | | |

**Contributed by Louis H. Frick, MACHINERY's Data Sheet No. 74. Explanatory notes: Pages 3 and 7.**

## DIMENSIONS OF STANDARD WROUGHT-IRON PIPE—II

| Nominal Inside Diameter. | Internal Circumference. | External Circumference. | Length of Pipe per Sq. Ft. of Internal Surface. | Length of Pipe per Sq. Ft. of External Surface. | Internal Area of Section. | Weight per Foot. | External Area of Section. | Cap'y in Gall's per Foot in Length. |  A. | Diameter of Boss. B. | Diameter of Recess. C. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/8" | .85 | 1.27 | 14.2' | 9.44' | .057 | .24 | .13 | .002 |  | 7/8" |  |
| 1/4" | 1.14 | 1.7 | 10.5' | 7.075' | .104 | .42 | .23 | .005 |  | 1" |  |
| 3/8" | 1.55 | 2.12 | 7.76' | 5.66' | .191 | .56 | .36 | .009 |  | 1 1/4" |  |
| 1/2" | 1.95 | 2.64 | 6.15' | 4.55' | .304 | .84 | .55 | .016 | 1/2" | 1 1/2" | 1 1/8" |
| 3/4" | 2.59 | 3.3 | 4.64' | 3.64' | .533 | 1.12 | .87 | .027 | 5/8" | 2" | 1 1/4" |
| 1" | 3.29 | 4.13 | 3.66' | 2.90' | .861 | 1.67 | 1.36 | .044 | 5/8" | 2 1/4" | 1 1/2" |
| 1 1/4" | 4.33 | 5.21 | 2.77' | 2.30' | 1.496 | 2.24 | 2.16 | .077 | 3/4" | 2 3/4" | 1 7/8" |
| 1 1/2" | 5.06 | 5.97 | 2.38' | 2.01' | 2.036 | 2.68 | 2.83 | .105 | 3/4" | 3" | 2 1/8" |
| 2" | 6.49 | 7.46 | 1.85' | 1.61' | 3.356 | 3.61 | 4.43 | .174 | 7/8" | 3 3/4" | 2 5/8" |
| 2 1/2" | 7.75 | 9.03 | 1.55' | 1.33' | 4.78 | 5.74 | 6.49 | .248 | 1" | 4 1/4" | 3 1/8" |
| 3" | 9.63 | 10.99 | 1.25' | 1.09' | 7.383 | 7.54 | 9.62 | .384 | 1" | 5" | 3 3/4" |
| 3 1/2" | 11.15 | 12.57 | 1.08' | 0.955' | 9.886 | 9.00 | 12.57 | .514 | 1" | 5 3/4" | 4 1/4" |
| 4" | 12.65 | 14.14 | .95' | 0.849' | 12.73 | 10.66 | 15.90 | .661 | 1" | 6 1/2" | 4 3/4" |
| 4 1/2" | 14.16 | 15.71 | 85' | 0.764' | 15.96 | 12.34 | 19.63 | 829 | 1" | 7" | 5 1/4" |
| 5" | 15.85 | 17.47 | .76' | 0.687' | 19.99 | 14.50 | 24.30 | 1.02 | 1" | 8 1/4" | 5 3/4" |
| 6" | 19.05 | 20.81 | .63' | 0.577' | 28.886 | 18.76 | 34.47 | 1.50 | 1 1/8" | 9 1/2" | 6 7/8" |
| 7" | 22.06 | 23.95 | .54' | 0.501' | 38.743 | 23.27 | 45.66 | 2.01 | 1 1/8" | 10 1/2" | 7 7/8" |
| 8" | 25.07 | 27.10 | .48' | 0.443' | 50.021 | 28.18 | 58.43 | 2.60 | 1 1/4" | 11 3/4" | 8 7/8" |
| 9" | 28.08 | 30.24 | .43' | 0.397' | 62.722 | 33.70 | 72.76 | 3.26 | 1 3/8" | 12" | 9 7/8" |
| 10" | 31.47 | 33.77 | .38' | 0.355' | 78.822 | 40.06 | 90.76 | 4.08 | 1 1/2" | 13" | 11" |
| 11" | 34.56 | 36.91 | .35' | 0.325' | 95.03 | 45.95 | 108.43 | 4.93 | 1 1/2" | 14" | 12 1/4" |
| 12" | 37.70 | 40.05 | .32' | 0.299' | 113.09 | 48.98 | 127.68 | 5.87 | 1 5/8" | 16" | 13 1/4" |
| 13" | 41.62 | 43.98 | .29' | 0.273' | 137.88 | 54.61 | 153.93 | 7.163 | 1 5/8" | 18" | 14 1/2" |
| 14" | 44.76 | 47.12 | .27' | 0.255' | 159.48 | 58.62 | 176.71 | 8.28 | 1 5/8" | 19" | 15 3/4" |
| 15" | 47.91 | 50.26 | .25' | 0.24' | 182.66 | 62.63 | 201.06 | 9.48 | 1 3/4" | 21" | 17" |
| 16" | 51.52 | 53.41 | .22' | 0.212' | 211.24 | 66.64 | 226.98 | 10.44 | 1 3/4" | 22" | 18" |
| 17" | 54.19 | 56.55 | .22' | 0.21' | 239.70 | 70.65 | 254.47 | 12.14 | 1 3/4" | 24" | 19" |
| 18" | 57.49 | 59.69 | .21' | 0.20' | 263.02 | 72.55 | 283.53 | 13.66 | 1 7/8" | 25" | 20" |
| 19" | 60.48 | 62.83 | .198' | 0.191' | 291.04 | 78.67 | 314.16 | 15.12 | 1 7/8" | 26" | 21" |
| 20" | 63.46 | 65.97 | 19' | 0.18' | 320.47 | 82.68 | 346.36 | 16.65 | 2" | 28" | 22" |
| *Taper of Conical Tube Ends 3/4" in Diam. in 12"* |  |  |  |  |  |  |  |  |  |  |  |

Contributed by Louis H. Frick, MACHINERY'S Data Sheet No. 74. Explanatory notes: Pages 3 and 7.

# ELEMENTS OF STANDARD PIPE SECTIONS.

| Nominal Size. | Tap Drill. | Outside Diameter. | Internal Diameter. | Internal Area, Sq. In. | Area of Metal, Sq. In. | Moment of Inertia | Section Modulus. | Radius of Gyration. | Square of Radius of Gyration. | Weight per foot in Pounds. | Threads per Inch. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | T | D | d | a | A | I | $\frac{I}{\frac{1}{2}D}$ | R | $R^2$ | W | t |
| ⅛ | 11/32 | .405 | .27 | .0573 | .072 | .001 | .005 | .122 | .015 | .241 | 27 |
| ¼ | 7/16 | .54 | .364 | .1041 | .125 | .003 | .012 | .163 | .027 | .420 | 18 |
| ⅜ | 9/16 | .675 | .494 | .1917 | .166 | .007 | .022 | .209 | .044 | .559 | 18 |
| ½ | 11/16 | .84 | .623 | .3048 | .249 | .017 | .041 | .262 | .068 | .837 | 14 |
| ¾ | 15/16 | 1.05 | .824 | .5333 | .333 | .037 | .071 | .334 | .111 | 1.12 | 14 |
| 1 | 1 3/16 | 1.315 | 1.048 | .8626 | .495 | .087 | .133 | .420 | .177 | 1.68 | 11½ |
| 1¼ | 1½ | 1.66 | 1.38 | 1.496 | .668 | .195 | .235 | .540 | .291 | 2.24 | 11½ |
| 1½ | 1¾ | 1.9 | 1.611 | 2.038 | .797 | .309 | .325 | .681 | .463 | 3.68 | 11½ |
| 2 | 2¼ | 2.375 | 2.067 | 3.356 | 1.07 | .666 | .561 | .787 | .620 | 4.61 | 11½ |
| 2½ | 2 11/16 | 2.875 | 2.468 | 4.784 | 1.71 | 1.53 | 1.07 | .947 | .898 | 5.74 | 8 |
| 3 | 3 5/16 | 3.5 | 3.067 | 7.388 | 2.24 | 3.02 | 1.73 | 1.16 | 1.35 | 7.54 | 8 |
| 3½ | 3 13/16 | 4.0 | 3.548 | 9.887 | 2.68 | 4.79 | 2.39 | 1.34 | 1.79 | 9.00 | 8 |
| 4 | 4 5/16 | 4.5 | 4.026 | 12.73 | 3.17 | 7.23 | 3.21 | 1.51 | 2.28 | 10.7 | 8 |
| 4½ |  | 5.0 | 4.508 | 15.96 | 3.67 | 10.41 | 4.16 | 1.68 | 2.83 | 12.3 | 8 |
| 5 |  | 5.563 | 5.045 | 19.99 | 4.32 | 15.2 | 5.47 | 1.88 | 3.52 | 14.5 | 8 |
| 6 |  | 6.625 | 6.065 | 28.89 | 5.58 | 28.2 | 8.50 | 2.25 | 5.04 | 18.8 | 8 |
| 7 |  | 7.625 | 7.023 | 38.74 | 6.93 | 46.5 | 12.2 | 2.59 | 6.72 | 23.3 | 8 |
| 8 |  | 8.625 | 7.982 | 50.04 | 8.39 | 72.4 | 16.8 | 2.94 | 8.63 | 28.2 | 8 |
| 9 |  | 9.625 | 8.937 | 62.73 | 10.03 | 108. | 22.9 | 3.28 | 10.8 | 33.7 | 8 |
| 10 |  | 10.75 | 10.019 | 78.84 | 11.92 | 161. | 29.9 | 3.67 | 13.5 | 40.1 | 8 |
| 11 |  | 11.75 | 11.25 | 99.40 | 13.70 | 232. | 38.6 | 4.12 | 16.9 | 46.0 | 8 |
| 12 |  | 12.75 | 12.00 | 113.1 | 14.58 | 279. | 42.8 | 4.38 | 19.2 | 49.0 | 8 |
| 14 O. D. |  | 14.00 | 13.25 | 137.9 | 16.05 | 373. | 53.3 | 4.82 | 23.2 | 53.9 | 8 |
| 15 O. D. |  | 15.00 | 14.25 | 159.5 | 17.23 | 461. | 61.5 | 5.15 | 26.5 | 57.9 | 8 |
| 16 O. D. |  | 16.00 | 15.25 | 182.6 | 18.41 | 562. | 70.3 | 5.53 | 30.5 | 61.8 | 8 |

Contributed by John S. Myers, MACHINERY'S Data Sheet No. 20. Explanatory note: Page 7.

## ELEMENTS OF EXTRA STRONG PIPE SECTIONS.

| N | D | d | a | A | I | $\frac{I}{\frac{1}{2}D}$ | R | $R^2$ | W |
|---|---|---|---|---|---|---|---|---|---|
| ⅛ | .405 | .205 | .033 | .086 | .001 | .006 | .114 | .013 | .29 |
| ¼ | .54 | .294 | .068 | .161 | .004 | .014 | .154 | .024 | .54 |
| ⅜ | .675 | .425 | .139 | .219 | .009 | .025 | .200 | .040 | .74 |
| ½ | .84 | .542 | .231 | .323 | .020 | .048 | .250 | .062 | 1.09 |
| ¾ | 1.05 | .736 | .452 | .414 | .045 | .086 | .321 | .103 | 1.39 |
| 1 | 1.315 | .951 | .710 | .648 | .107 | .162 | .406 | .165 | 2.17 |
| 1¼ | 1.66 | 1.272 | 1.27 | .893 | .244 | .270 | .523 | .273 | 3.00 |
| 1½ | 1.9 | 1.494 | 1.75 | 1.08 | .395 | .416 | .605 | .365 | 3.63 |
| 2 | 2.375 | 1.933 | 2.94 | 1.50 | .877 | .738 | .766 | .586 | 5.02 |
| 2½ | 2.875 | 2.315 | 4.21 | 2.28 | 1.94 | 1.35 | .923 | .852 | 7.67 |
| 3 | 3.5 | 2.892 | 6.57 | 3.05 | 3.93 | 2.28 | 1.14 | 1.29 | 10.3 |
| 3½ | 4.0 | 3.358 | 8.86 | 3.71 | 6.33 | 3.16 | 1.31 | 1.70 | 12.5 |
| 4 | 4.5 | 3.818 | 11.45 | 4.45 | 9.72 | 4.32 | 1.48 | 2.18 | 15.0 |
| 5 | 5.563 | 4.813 | 18.19 | 6.12 | 20.7 | 7.43 | 1.84 | 3.38 | 20.5 |
| 6 | 6.625 | 5.750 | 25.97 | 8.51 | 40.9 | 12.4 | 2.19 | 4.81 | 28.6 |

## ELEMENTS OF DOUBLE EXTRA STRONG PIPE SECTIONS.

| N | D | d | a | A | I | $\frac{I}{\frac{1}{2}D}$ | R | $R^2$ | W |
|---|---|---|---|---|---|---|---|---|---|
| ½ | .84 | .244 | .047 | .507 | .024 | .058 | .213 | .048 | 1.70 |
| ¾ | 1.05 | .422 | .139 | .727 | .058 | .111 | .283 | .080 | 2.44 |
| 1 | 1.315 | .587 | .271 | 1.09 | .141 | .214 | .360 | .130 | 3.65 |
| 1¼ | 1.66 | .885 | .615 | 1.55 | .343 | .413 | .471 | .221 | 5.20 |
| 1½ | 1.9 | 1.088 | .93 | 1.91 | .571 | .601 | .547 | .300 | 6.40 |
| 2 | 2.375 | 1.491 | 1.74 | 2.69 | 1.32 | 1.11 | .701 | .491 | 9.02 |
| 2½ | 2.875 | 1.755 | 2.42 | 4.07 | 2.89 | 2.01 | .842 | .709 | 13.7 |
| 3 | 3.5 | 2.284 | 4.10 | 5.52 | 6.03 | 3.45 | 1.05 | 1.09 | 18.6 |
| 3½ | 4.0 | 2.716 | 5.79 | 6.77 | 9.90 | 4.95 | 1.21 | 1.46 | 22.7 |
| 4 | 4.5 | 3.136 | 7.72 | 8.18 | 15.4 | 6.84 | 1.37 | 1.88 | 27.5 |
| 5 | 5.563 | 4.063 | 12.97 | 11.34 | 33.6 | 12.1 | 1.72 | 2.96 | 38.1 |
| 6 | 6.625 | 4.875 | 18.67 | 15.90 | 66.9 | 20.2 | 2.06 | 4.23 | 53.1 |

Contributed by John S. Myers, MACHINERY'S Data Sheet No. 20. Explanatory note: Page 7.

# SHELBY STANDARD COLD DRAWN TUBING—I

## Inside Diameter in Inches
## For Shelby Standard Cold Drawn Mechanical Tubing

| Outside Diam., Inches | Thickness in Gage and Fractions of an Inch | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 BWG | 20 BWG | 18 BWG | 1/16 | 3/32 | 1/8 | 5/32 | 3/16 | 7/32 | 1/4 | 5/16 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 |
| 1/2 | 0.444 | 0.430 | 0.402 | 0.375 | 0.3125 | 0.250 | | | | | | | | | | | |
| 5/8 | 0.569 | 0.555 | 0.527 | 0.500 | 0.4375 | 0.375 | | | | | | | | | | | |
| 3/4 | 0.694 | 0.680 | 0.652 | 0.625 | 0.5625 | 0.500 | 0.4375 | 0.375 | | | | | | | | | |
| 7/8 | 0.819 | 0.805 | 0.777 | 0.750 | 0.6875 | 0.625 | 0.5625 | 0.500 | 0.4375 | | | | | | | | |
| 1 | 0.944 | 0.930 | 0.902 | 0.875 | 0.8125 | 0.750 | 0.6875 | 0.625 | 0.5625 | 0.500 | | | | | | | |
| 1 1/8 | 1.069 | 1.055 | 1.027 | 1.000 | 0.9375 | 0.875 | 0.8125 | 0.750 | 0.6875 | 0.625 | | | | | | | |
| 1 1/4 | 1.194 | 1.180 | 1.152 | 1.125 | 1.0625 | 1.000 | 0.9375 | 0.875 | 0.8125 | 0.750 | 0.625 | 0.500 | | | | | |
| 1 3/8 | | 1.305 | 1.277 | 1.250 | 1.1875 | 1.125 | 1.0625 | 1.000 | 0.9375 | 0.875 | 0.750 | 0.625 | | | | | |
| 1 1/2 | | 1.430 | 1.402 | 1.375 | 1.3125 | 1.250 | 1.1875 | 1.125 | 1.0625 | 1.000 | 0.875 | 0.750 | 0.500 | | | | |
| 1 3/4 | | | | 1.625 | 1.5625 | 1.500 | 1.4375 | 1.375 | 1.3125 | 1.250 | 1.125 | 1.000 | 0.750 | | | | |
| 2 | | | | 1.875 | 1.8125 | 1.750 | 1.6875 | 1.625 | 1.5625 | 1.500 | 1.375 | 1.250 | 1.000 | 0.750 | | | |
| 2 1/4 | | | | 2.125 | 2.0625 | 2.000 | 1.9375 | 1.875 | 1.8125 | 1.750 | 1.625 | 1.500 | 1.250 | 1.000 | | | |
| 2 1/2 | | | | 2.375 | 2.3125 | 2.250 | 2.1875 | 2.125 | 2.0625 | 2.000 | 1.875 | 1.750 | 1.500 | 1.250 | | | |
| 2 3/4 | | | | 2.625 | 2.5625 | 2.500 | 2.4375 | 2.375 | 2.3125 | 2.250 | 2.125 | 2.000 | 1.750 | 1.500 | | | |
| 3 | | | | | 2.8125 | 2.750 | 2.6875 | 2.625 | 2.5625 | 2.500 | 2.375 | 2.250 | 2.000 | 1.750 | 1.500 | 1.250 | 1.000 |
| 3 1/4 | | | | | 3.0625 | 3.000 | 2.9375 | 2.875 | 2.8125 | 2.750 | 2.625 | 2.500 | 2.250 | 2.000 | 1.750 | 1.500 | 1.250 |
| 3 1/2 | | | | | 3.3125 | 3.250 | 3.1875 | 3.125 | 3.0625 | 3.000 | 2.875 | 2.750 | 2.500 | 2.250 | 2.000 | 1.750 | 1.500 |
| 3 3/4 | | | | | | 3.500 | 3.4375 | 3.375 | 3.3125 | 3.250 | 3.125 | 3.000 | 2.750 | 2.500 | 2.250 | 2.000 | 1.750 |
| 4 | | | | | | 3.750 | 3.6875 | 3.625 | 3.5625 | 3.500 | 3.375 | 3.250 | 3.000 | 2.750 | 2.500 | 2.250 | 2.000 |
| 4 1/4 | | | | | | | 3.9375 | 3.875 | 3.8125 | 3.750 | 3.625 | 3.500 | 3.250 | 3.000 | 2.750 | 2.500 | 2.250 |
| 4 1/2 | | | | | | | 4.1875 | 4.125 | 4.0625 | 4.000 | 3.875 | 3.750 | 3.500 | 3.250 | 3.000 | 2.750 | 2.500 |
| 4 3/4 | | | | | | | 4.4375 | 4.375 | 4.3125 | 4.250 | 4.125 | 4.000 | 3.750 | 3.500 | 3.250 | 3.000 | 2.750 |
| 5 | | | | | | | 4.6875 | 4.625 | 4.5625 | 4.500 | 4.375 | 4.250 | 4.000 | 3.750 | 3.500 | 3.250 | 3.000 |
| 5 1/2 | | | | | | | 5.1875 | 5.125 | 5.0625 | 5.000 | 4.875 | 4.750 | 4.500 | 4.250 | 4.000 | 3.750 | 3.500 |

National Tube Company's Standard. Explanatory note: Page 7.

## SHELBY STANDARD COLD DRAWN TUBING—II

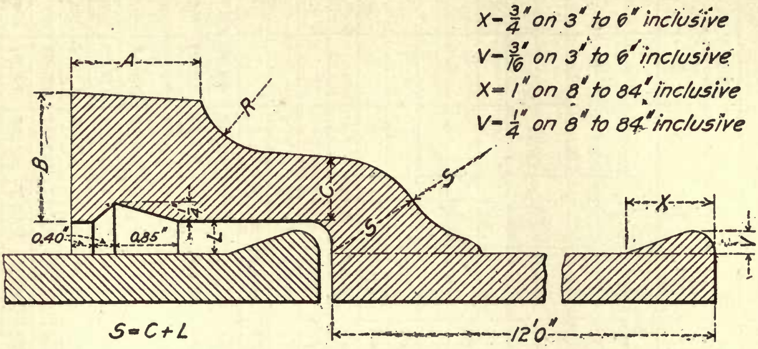
### Weight in Pounds Per Lineal Foot For Shelby Standard Cold Drawn Mechanical Tubing

Based on weight, one cubic inch of steel = 0.2833 pound

| Outside Diam., Inches | Thickness in Gage and Fractions of an Inch | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 BWG | 20 BWG | 18 BWG | $\frac{1}{16}$ | $\frac{3}{32}$ | $\frac{1}{8}$ | $\frac{5}{32}$ | $\frac{3}{16}$ | $\frac{7}{32}$ | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ | $\frac{7}{8}$ | 1 |
| $\frac{1}{2}$ | 0.141 | 0.174 | 0.236 | 0.292 | 0.407 | 0.501 | | | | | | | | | | | |
| $\frac{5}{8}$ | 0.179 | 0.221 | 0.301 | 0.375 | 0.532 | 0.668 | | | | | | | | | | | |
| $\frac{3}{4}$ | 0.216 | 0.267 | 0.367 | 0.459 | 0.657 | 0.834 | 0.991 | 1.13 | | | | | | | | | |
| $\frac{7}{8}$ | 0.253 | 0.314 | 0.432 | 0.542 | 0.782 | 1.00 | 1.20 | 1.38 | 1.53 | | | | | | | | |
| 1 | 0.291 | 0.361 | 0.498 | 0.626 | 0.907 | 1.17 | 1.41 | 1.63 | 1.83 | 2.00 | | | | | | | |
| $1\frac{1}{8}$ | 0.328 | 0.407 | 0.563 | 0.709 | 1.03 | 1.34 | 1.62 | 1.88 | 2.12 | 2.34 | | | | | | | |
| $1\frac{1}{4}$ | 0.365 | 0.454 | 0.629 | 0.793 | 1.16 | 1.50 | 1.83 | 2.13 | 2.41 | 2.67 | 3.13 | 3.50 | | | | | |
| $1\frac{3}{8}$ | | 0.501 | 0.694 | 0.876 | 1.28 | 1.67 | 2.03 | 2.38 | 2.70 | 3.00 | 3.55 | 4.01 | | | | | |
| $1\frac{1}{2}$ | | 0.548 | 0.759 | 0.960 | 1.41 | 1.84 | 2.24 | 2.63 | 2.99 | 3.34 | 3.96 | 4.51 | 5.34 | | | | |
| $1\frac{3}{4}$ | | | | 1.13 | 1.66 | 2.17 | 2.66 | 3.13 | 3.58 | 4.01 | 4.80 | 5.51 | 6.68 | | | | |
| 2 | | | | 1.29 | 1.91 | 2.50 | 3.08 | 3.63 | 4.16 | 4.67 | 5.63 | 6.51 | 8.01 | 9.18 | | | |
| $2\frac{1}{4}$ | | | | 1.46 | 2.16 | 2.84 | 3.49 | 4.13 | 4.75 | 5.34 | 6.47 | 7.51 | 9.35 | 10.85 | | | |
| $2\frac{1}{2}$ | | | | 1.63 | 2.41 | 3.17 | 3.91 | 4.63 | 5.33 | 6.01 | 7.30 | 8.51 | 10.68 | 12.52 | | | |
| $2\frac{3}{4}$ | | | | 1.79 | 2.66 | 3.50 | 4.33 | 5.13 | 5.91 | 6.68 | 8.14 | 9.51 | 12.02 | 14.18 | | | |
| 3 | | | | | 2.91 | 3.84 | 4.75 | 5.63 | 6.50 | 7.34 | 8.97 | 10.51 | 13.35 | 15.85 | 18.02 | 19.86 | 21.36 |
| $3\frac{1}{4}$ | | | | | 3.16 | 4.17 | 5.16 | 6.13 | 7.08 | 8.01 | 9.80 | 11.51 | 14.69 | 17.52 | 20.03 | 22.19 | 24.03 |
| $3\frac{1}{2}$ | | | | | 3.41 | 4.51 | 5.58 | 6.63 | 7.67 | 8.68 | 10.64 | 12.52 | 16.02 | 19.19 | 22.03 | 24.53 | 26.70 |
| $3\frac{3}{4}$ | | | | | | 4.84 | 6.00 | 7.13 | 8.25 | 9.35 | 11.47 | 13.52 | 17.36 | 20.86 | 24.03 | 26.87 | 29.37 |
| 4 | | | | | | 5.17 | 6.41 | 7.63 | 8.83 | 10.01 | 12.31 | 14.52 | 18.69 | 22.53 | 26.03 | 29.20 | 32.04 |
| $4\frac{1}{4}$ | | | | | | | 6.83 | 8.14 | 9.42 | 10.68 | 13.14 | 15.52 | 20.03 | 24.20 | 28.04 | 31.54 | 34.71 |
| $4\frac{1}{2}$ | | | | | | | 7.25 | 8.64 | 10.00 | 11.35 | 13.98 | 16.52 | 21.36 | 25.87 | 30.04 | 33.88 | 37.38 |
| $4\frac{3}{4}$ | | | | | | | 7.67 | 9.14 | 10.59 | 12.02 | 14.81 | 17.52 | 22.70 | 27.53 | 32.04 | 36.21 | 40.05 |
| 5 | | | | | | | 8.08 | 9.64 | 11.17 | 12.68 | 15.64 | 18.52 | 24.03 | 29.20 | 34.04 | 38.55 | 42.72 |
| $5\frac{1}{2}$ | | | | | | | 8.92 | 10.64 | 12.34 | 14.02 | 17.31 | 20.53 | 26.70 | 32.54 | 38.05 | 43.22 | 48.06 |

National Tube Company's Standard. Explanatory note: Page 7.

## AMERICAN WATER WORKS ASSOCIATION STANDARD PIPE—I


X–3/4" on 3" to 6" inclusive
V–3/16" on 3" to 6" inclusive
X=1" on 8" to 84" inclusive
V–1/4" on 8" to 84" inclusive
A
B
R
C
S
S
0.40"
0.85"
L
X
V
12'0"
S=C+L

| Nominal Diam., Inches | Classes | Actual Outside Diam., Inches | Diam. of Sockets | | Depth of Sockets | | A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| | | | Pipe, Inches | Special Castings, Inches | Pipe, Inches | Special Castings, Inches | | | |
| 4 | A | 4.80 | 5.60 | 5.70 | 3.50 | 4.00 | 1.50 | 1.30 | 0.65 |
| 4 | B–C–D | 5.00 | 5.80 | 5.70 | 3.50 | 4.00 | 1.50 | 1.30 | 0.65 |
| 6 | A | 6.90 | 7.70 | 7.80 | 3.50 | 4.00 | 1.50 | 1.40 | 0.70 |
| 6 | B–C–D | 7.10 | 7.90 | 7.80 | 3.50 | 4.00 | 1.50 | 1.40 | 0.70 |
| 8 | A–B | 9.05 | 9.85 | 10.00 | 4.00 | 4.00 | 1.50 | 1.50 | 0.75 |
| 8 | C–D | 9.30 | 10.10 | 10.00 | 4.00 | 4.00 | 1.50 | 1.50 | 0.75 |
| 10 | A–B | 11.10 | 11.90 | 12.10 | 4.00 | 4.00 | 1.50 | 1.50 | 0.75 |
| 10 | C–D | 11.40 | 12.20 | 12.10 | 4.00 | 4.00 | 1.50 | 1.60 | 0.80 |
| 12 | A–B | 13.20 | 14.00 | 14.20 | 4.00 | 4.00 | 1.50 | 1.60 | 0.80 |
| 12 | C–D | 13.50 | 14.30 | 14.20 | 4.00 | 4.00 | 1.50 | 1.70 | 0.85 |
| 14 | A–B | 15.30 | 16.10 | 16.10 | 4.00 | 4.00 | 1.50 | 1.70 | 0.85 |
| 14 | C–D | 15.65 | 16.45 | 16.45 | 4.00 | 4.00 | 1.50 | 1.80 | 0.90 |
| 16 | A–B | 17.40 | 18.40 | 18.40 | 4.00 | 4.00 | 1.75 | 1.80 | 0.90 |
| 16 | C–D | 17.80 | 18.80 | 18.80 | 4.00 | 4.00 | 1.75 | 1.90 | 1.00 |
| 18 | A–B | 19.50 | 20.50 | 20.50 | 4.00 | 4.00 | 1.75 | 1.90 | 0.95 |
| 18 | C–D | 19.92 | 20.92 | 20.92 | 4.00 | 4.00 | 1.75 | 2.10 | 1.05 |
| 20 | A–B | 21.60 | 22.60 | 22.60 | 4.00 | 4.00 | 1.75 | 2.00 | 1.00 |
| 20 | C–D | 22.06 | 23.06 | 23.06 | 4.00 | 4.00 | 1.75 | 2.30 | 1.15 |
| 24 | A–B | 25.80 | 26.80 | 26.80 | 4.00 | 4.00 | 2.00 | 2.10 | 1.05 |
| 24 | C–D | 26.32 | 27.32 | 27.32 | 4.00 | 4.00 | 2.00 | 2.50 | 1.25 |

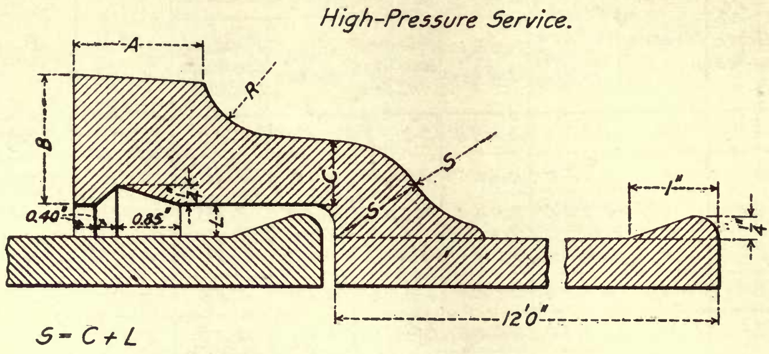
Explanatory note: Page 7.

## AMERICAN WATER WORKS ASSOCIATION STANDARD PIPE—II

| Nominal Diam., Inches | Classes | Actual Outside Diam., Inches | Diam. of Sockets | | Depth of Sockets | | A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| | | | Pipe, Inches | Special Castings, Inches | Pipe, Inches | Special Castings, Inches | | | |
| 30 | A | 31.74 | 32.74 | 32.74 | 4.50 | 4.50 | 2.00 | 2.30 | 1.15 |
| 30 | B | 32.00 | 33.00 | 33.00 | 4.50 | 4.50 | 2.00 | 2.30 | 1.15 |
| 30 | C | 32.40 | 33.40 | 33.40 | 4.50 | 4.50 | 2.00 | 2.60 | 1.32 |
| 30 | D | 32.74 | 33.74 | 33.74 | 4.50 | 4.50 | 2.00 | 3.00 | 1.50 |
| 36 | A | 37.96 | 38.96 | 38.96 | 4.50 | 4.50 | 2.00 | 2.50 | 1.25 |
| 36 | B | 38.30 | 39.30 | 39.30 | 4.50 | 4.50 | 2.00 | 2.80 | 1.40 |
| 36 | C | 38.70 | 39.70 | 39.70 | 4.50 | 4.50 | 2.00 | 3.10 | 1.60 |
| 36 | B | 39.16 | 40.16 | 40.16 | 4.50 | 4.50 | 2.00 | 3.40 | 1.80 |
| 42 | A | 44.20 | 45.20 | 45.20 | 5.00 | 5.00 | 2.00 | 2.80 | 1.40 |
| 42 | B | 44.50 | 45.50 | 45.50 | 5.00 | 5.00 | 2.00 | 3.00 | 1.50 |
| 42 | C | 45.10 | 46.10 | 46.10 | 5.00 | 5.00 | 2.00 | 3.40 | 1.75 |
| 42 | D | 45.58 | 46.58 | 46.58 | 5.00 | 5.00 | 2.00 | 3.80 | 1.95 |
| 48 | A | 50.50 | 51.50 | 51.50 | 5.00 | 5.00 | 2.00 | 3.00 | 1.50 |
| 48 | B | 50.80 | 51.80 | 51.80 | 5.00 | 5.00 | 2.00 | 3.30 | 1.65 |
| 48 | C | 51.40 | 52.40 | 52.40 | 5.00 | 5.00 | 2.00 | 3.80 | 1.95 |
| 48 | D | 51.98 | 52.98 | 52.98 | 5.00 | 5.00 | 2.00 | 4.20 | 2.20 |
| 54 | A | 56.66 | 57.66 | 57.66 | 5.50 | 5.50 | 2.25 | 3.20 | 1.60 |
| 54 | B | 57.10 | 58.10 | 58.10 | 5.50 | 5.50 | 2.25 | 3.60 | 1.80 |
| 54 | C | 57.80 | 58.80 | 58.80 | 5.50 | 5.50 | 2.25 | 4.00 | 2.15 |
| 54 | D | 58.40 | 59.40 | 59.40 | 5.50 | 5.50 | 2.25 | 4.40 | 2.45 |
| 60 | A | 62.80 | 63.80 | 63.80 | 5.50 | 5.50 | 2.25 | 3.40 | 1.70 |
| 60 | B | 63.40 | 64.40 | 64.40 | 5.50 | 5.50 | 2.25 | 3.70 | 1.90 |
| 60 | C | 64.20 | 65.20 | 65.20 | 5.50 | 5.50 | 2.25 | 4.20 | 2.25 |
| 60 | D | 64.82 | 65.82 | 65.82 | 5.50 | 5.50 | 2.25 | 4.70 | 2.60 |
| 72 | A | 75.34 | 76.34 | 76.34 | 5.50 | 5.50 | 2.25 | 3.80 | 1.87 |
| 72 | B | 76.00 | 77.00 | 77.00 | 5.50 | 5.50 | 2.25 | 4.20 | 2.20 |
| 72 | C | 76.88 | 77.88 | 77.88 | 5.50 | 5.50 | 2.25 | 4.60 | 2.64 |
| 84 | A | 87.54 | 88.54 | 88.54 | 5.50 | 5.50 | 2.50 | 4.10 | 2.10 |
| 84 | B | 88.54 | 89.54 | 89.54 | 5.50 | 5.50 | 2.50 | 4.50 | 2.60 |

Explanatory note: Page 7.

## AMERICAN WATER WORKS ASSOCIATION STANDARD PIPE—III



| Nominal Diam., Inches | Classes | Actual Outside Diam., Inches | Diam. of Sockets | Depth of Sockets | A | B | C | R |
|---|---|---|---|---|---|---|---|---|
| | | | Pipe and Specials | Pipe and Specials | | | | |
| 6 | E-F | 7.22 | 8.02 | 4.00 | 1.50 | 1.75 | 0.75 | 1.10 |
| 6 | G-H | 7.38 | 8.18 | 4.00 | 1.50 | 1.85 | 0.85 | 1.10 |
| 8 | E-F | 9.42 | 10.22 | 4.00 | 1.50 | 1.85 | 0.85 | 1.10 |
| 8 | G-H | 9.60 | 10.40 | 4.00 | 1.50 | 1.95 | 0.95 | 1.10 |
| 10 | E-F | 11.60 | 12.40 | 4.50 | 1.75 | 1.95 | 0.95 | 1.10 |
| 10 | G-H | 11.84 | 12.64 | 4.50 | 1.75 | 2.05 | 1.05 | 1.10 |
| 12 | E-F | 13.78 | 14.58 | 4.50 | 1.75 | 2.05 | 1.05 | 1.10 |
| 12 | G-H | 14.08 | 14.88 | 4.50 | 1.75 | 2.20 | 1.20 | 1.10 |
| 14 | E-F | 15.98 | 16.78 | 4.50 | 2.00 | 2.15 | 1.15 | 1.10 |
| 14 | G-H | 16.32 | 17.12 | 4.50 | 2.00 | 2.35 | 1.35 | 1.10 |
| 16 | E-F | 18.16 | 18.96 | 4.50 | 2.00 | 2.30 | 1.25 | 1.15 |
| 16 | G-H | 18.54 | 19.34 | 4.50 | 2.00 | 2.55 | 1.45 | 1.15 |
| 18 | E-F | 20.34 | 21.14 | 4.50 | 2.25 | 2.45 | 1.40 | 1.15 |
| 18 | G-H | 20.78 | 21.58 | 4.50 | 2.25 | 2.75 | 1.65 | 1.15 |
| 20 | E-F | 22.54 | 23.34 | 4.50 | 2.25 | 2.55 | 1.50 | 1.15 |
| 20 | G-H | 23.02 | 23.82 | 4.50 | 2.25 | 2.85 | 1.75 | 1.20 |
| 24 | E-F | 26.90 | 27.90 | 5.00 | 2.25 | 2.85 | 1.70 | 1.20 |
| 30 | E | 33.10 | 34.10 | 5.00 | 2.25 | 3.25 | 1.80 | 1.50 |
| 30 | F | 33.46 | 34.46 | 5.00 | 2.25 | 3.50 | 2.00 | 1.55 |
| 36 | E | 39.60 | 40.60 | 5.00 | 2.25 | 3.70 | 2.05 | 1.70 |
| 36 | F | 40.04 | 41.04 | 5.00 | 2.25 | 4.00 | 2.30 | 1.80 |

Explanatory note: Page 7.

per square inch, respectively. [MACHINERY, November, 1909, Pipe Fittings, Theory vs. Practice in Their Manufacture; May, 1910, Establishing a Commercial Standard for Pipe Fittings.]

### Miscellaneous Pipe Fittings and Accessories

On pages 32, 33 and 34 are given dimensions of the United States Navy standard composition flanges for copper pipes, the three tables covering pressures up to 100 pounds, from 101 to 300 pounds, and from 301 to 500 pounds per square inch, respectively.

On page 35 are given dimensions of so-called swing-joints used extensively in the water service systems of large steam engines. The table on page 36 gives dimensions for brazing unions for brass tubing. These are used extensively in cases where tubing is frequently connected and disconnected. On page 37 is given a table of standard hydraulic pipe flanges of cast-iron, intended for pressures up to 550 pounds per square inch.

### Pipe Bends

In the modern power house, steel pipe bends of large radius are nearly always used in preference to steel or cast-iron fittings. There are several very good reasons for this. In the first place, using bends in preference to fittings does away with many extra joints which are liable to cause leakage, and which are, in many cases, a constant source of trouble, requiring the renewing of gaskets, etc. In the second place, in steam lines or water lines of high temperature, the steel pipe bends provide a ready means of taking up expansion and contraction, and it is customary to use special bends for this purpose, known as expansion bends. In the third place, steel pipe bends permit the elimination of many steel castings. The cost of bends is less, and they can be delivered quicker. They also give a neater appearance to the engine-room, in general, than it has when covered with fittings. The weight is also less, and owing to the large radii to which the pipes can be bent, they reduce the friction of the fluids conducted inside of them to a minimum.

The process of bending is as follows: One end of the pipe to be bent is first plugged. The pipe is then filled with sand, which is packed tightly, and the other end of the pipe is capped. The pipe is then placed in an oil-heated furnace, and the portion to be bent is heated to a red heat. It is then taken out and placed on the so-called bending table, which is made of cast-iron and securely bolted to a heavy foundation. This table is flat, and is cored all over with holes, spaced about six inches apart. Circular steel pins are inserted into these holes. The pipe is clamped between two or three pins, and bent around other pins set so as to give the required radius. A rope is attached to the end of the pipe, and the bending is accomplished by pulling this rope with a winch or other suitable means.

After the pipe is bent to the required shape, it is cooled by running water with a hose over the heated portion. The purpose of the sand filling is to prevent the pipe from flattening when bending, which would necessarily occur in large pipes if they were not filled and well rammed down before bending. Should it happen that after the pipe has cooled off, it is found that it does not agree with the required measurements, it can be reheated and again pulled into shape. A man well experienced with pipe bending can, in most cases, bend a pipe to within ¼ inch, or even ⅛ inch, of the required dimensions. If the bends are made even as much as ½ inch or ¾ inch off the correct dimensions, they are quite easily drawn into position when erecting, at least if the line is of ordinary length, say 40 feet or more.

Large sizes of pipes, say up to 6 inches diameter, are very often bent by machine. A templet should first be provided

(Continued on page 44.)

## THICKNESS AND WEIGHT OF STANDARD CAST-IRON PIPE—I

| Nominal Inside Diameter, Inches | Class A<br>100-Feet Head<br>43 Pounds Pressure | | | Class B<br>200 Feet Head<br>86 Pounds Pressure | | | Class C<br>300 Feet Head<br>130 Pounds Pressure | | | Class D<br>400-Feet Head<br>173 Pounds Pressure | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | |
| | | Foot | Length | | Foot | Length | | Foot | Length | | Foot | Length |
| 4 | 0.42 | 20.0 | 240 | 0.45 | 21.7 | 260 | 0.48 | 23.3 | 280 | 0.52 | 25.0 | 300 |
| 6 | 0.44 | 30.8 | 370 | 0.48 | 33.3 | 400 | 0.51 | 35.8 | 430 | 0.55 | 38.3 | 460 |
| 8 | 0.46 | 42.9 | 515 | 0.51 | 47.5 | 570 | 0.56 | 52.1 | 625 | 0.60 | 55.8 | 670 |
| 10 | 0.50 | 57.1 | 685 | 0.57 | 63.8 | 765 | 0.62 | 70.8 | 850 | 0.68 | 76.7 | 920 |
| 12 | 0.54 | 72.5 | 870 | 0.62 | 82.1 | 985 | 0.68 | 91.7 | 1100 | 0.75 | 100.0 | 1200 |
| 14 | 0.57 | 89.6 | 1075 | 0.66 | 102.5 | 1230 | 0.74 | 116.7 | 1400 | 0.82 | 129.2 | 1550 |
| 16 | 0.60 | 108.3 | 1300 | 0.70 | 125.0 | 1500 | 0.80 | 143.8 | 1725 | 0.89 | 158.3 | 1900 |
| 18 | 0.64 | 129.2 | 1550 | 0.75 | 150.0 | 1800 | 0.87 | 175.0 | 2100 | 0.96 | 191.7 | 2300 |
| 20 | 0.67 | 150.0 | 1800 | 0.80 | 175.0 | 2100 | 0.92 | 208.3 | 2500 | 1.03 | 229.2 | 2750 |
| 24 | 0.76 | 204.2 | 2450 | 0.89 | 233.3 | 2800 | 1.04 | 279.2 | 3350 | 1.16 | 306.7 | 3680 |
| 30 | 0.88 | 291.7 | 3500 | 1.03 | 333.3 | 4000 | 1.20 | 400.0 | 4800 | 1.37 | 450.0 | 5400 |
| 36 | 0.99 | 391.7 | 4700 | 1.15 | 454.2 | 5450 | 1.36 | 545.8 | 6550 | 1.58 | 625.0 | 7500 |
| 42 | 1.10 | 512.5 | 6150 | 1.28 | 591.7 | 7100 | 1.54 | 716.7 | 8600 | 1.78 | 825.0 | 9900 |
| 48 | 1.26 | 666.7 | 8000 | 1.42 | 750.0 | 9000 | 1.71 | 908.3 | 10900 | 1.96 | 1050.0 | 12600 |
| 54 | 1.35 | 800.0 | 9600 | 1.55 | 933.3 | 11200 | 1.90 | 1141.7 | 13700 | 2.23 | 1341.7 | 16100 |
| 60 | 1.39 | 916.7 | 11000 | 1.67 | 1104.2 | 13250 | 2.00 | 1341.7 | 16100 | 2.38 | 1583.3 | 19000 |
| 72 | 1.62 | 1283.4 | 15400 | 1.95 | 1545.8 | 18550 | 2.39 | 1904.2 | 22850 | | | |
| 84 | 1.72 | 1633.4 | 19600 | 2.22 | 2104.2 | 25250 | | | | | | |

The above weights are per length to lay 12 feet, including standard sockets; proportionate allowance to be made for any variation.

Explanatory note: Page 7.

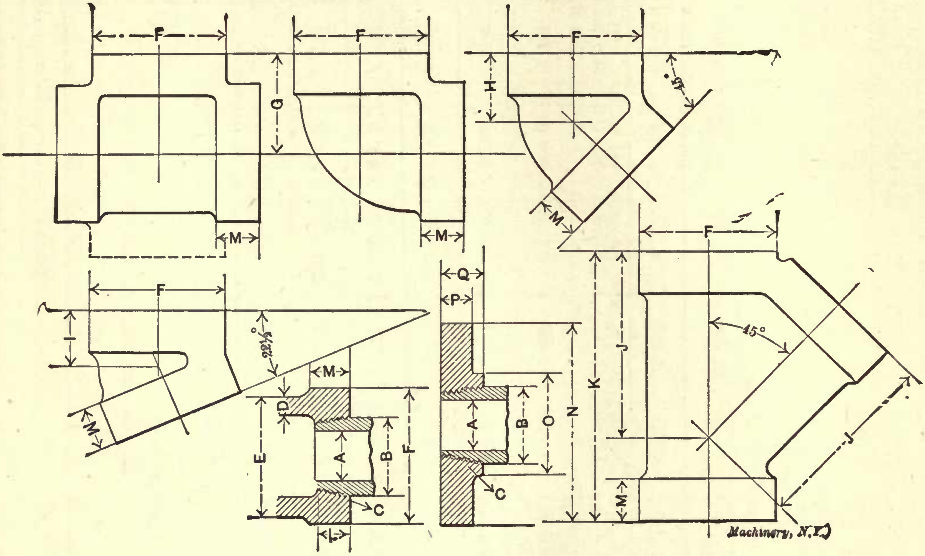
## THICKNESS AND WEIGHT OF STANDARD CAST-IRON PIPE—II

| For Fire Lines and Other High-Pressure Service. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal Inside Diameter, Inches | Class E 500 Feet Head 217 Pounds Pressure | | | Class F 600 Feet Head 260 Pounds Pressure | | | Class G 700 Feet Head 304 Pounds Pressure | | | Class H 800 Feet Head 347 Pounds Pressure | | |
| | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | | Thickness, Inches | Weight per | |
| | | Foot | Length | | Foot | Length | | Foot | Length | | Foot | Length |
| 6 | 0.58 | 41.7 | 500 | 0.61 | 43.3 | 520 | 0.65 | 47.1 | 565 | 0.69 | 49.6 | 595 |
| 8 | 0.66 | 61.7 | 740 | 0.71 | 65.7 | 790 | 0.75 | 70.8 | 850 | 0.80 | 75.0 | 900 |
| 10 | 0.74 | 86.3 | 1035 | 0.80 | 92.1 | 1105 | 0.86 | 100.9 | 1210 | 0.92 | 106.7 | 1280 |
| 12 | 0.82 | 113.8 | 1365 | 0.89 | 122.1 | 1465 | 0.97 | 135.4 | 1625 | 1.04 | 143.8 | 1725 |
| 14 | 0.90 | 145.0 | 1740 | 0.99 | 157.5 | 1890 | 1.07 | 174.2 | 2090 | 1.16 | 186.7 | 2240 |
| 16 | 0.98 | 179.6 | 2155 | 1.08 | 195.4 | 2345 | 1.18 | 219.2 | 2620 | 1.27 | 232.5 | 2790 |
| 18 | 1.07 | 220.4 | 2645 | 1.17 | 238.4 | 2860 | 1.28 | 267.1 | 3205 | 1.39 | 286.7 | 3440 |
| 20 | 1.15 | 263.0 | 3155 | 1.27 | 286.3 | 3435 | 1.39 | 320.8 | 3850 | 1.51 | 344.6 | 4135 |
| 24 | 1.31 | 359.6 | 4315 | 1.45 | 392.9 | 4715 | | | | | | |
| 30 | 1.55 | 521.7 | 6260 | 1.73 | 585.4 | 7025 | | | | | | |
| 36 | 1.80 | 725.0 | 8700 | 2.02 | 820.0 | 9840 | | | | | | |

*The above weights are per length to lay 12 feet, including standard sockets; proportionate allowance to be made for any variation.*

Explanatory note: Page 7.

# DIMENSIONS OF CAST IRON FITTINGS FOR WROUGHT IRON PIPE.



A. Size, or nominal inside diameter of wrought iron pipe.

B. Actual outside diameter of wrought iron pipe.

C. Number of threads to the inch.

D. Thickness of body.

E. Outside diameter of body.

F. Diameter at end of fitting.

G. Center to face of Tee, Cross and 90° Ell, or one-quarter bend.

H. Center to face of 45° Ell, or one-eighth bend.

I. Center to face of 22½° Ell, or one-sixteenth bend.

J. Center to face of 45° Y.

K. Face to face of 45° Y.

L. Length of threaded end.

M. Width of band.

N. Diameter of flange.

O. Diameter of flange hub.

P. Thickness of flange at edge.

Q. Thickness of flange through hub.

R. Number and size of bolts for flange.

S. Diameter of bolt circle for flange.

MACHINERY'S Data Sheet No. 45. Explanatory note: Page 7.

## CAST IRON FITTINGS—II

# DIMENSIONS OF CAST IRON FITTINGS FOR WROUGHT IRON PIPE.

**To withstand 100 pounds to the square inch.**

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⅛ | .41 | 27 | .09 | .61 | .81 | .63 | .54 | .47 | 1.08 | 1.58 | .25 | .25 |
| ¼ | .54 | 18 | .10 | .76 | .98 | .76 | .63 | .54 | 1.29 | 1.92 | .31 | .32 |
| ⅜ | .68 | 18 | .12 | .93 | 1.17 | .89 | .72 | .62 | 1.52 | 2.24 | .38 | .39 |
| ½ | .84 | 14 | .14 | 1.14 | 1.40 | 1.05 | .84 | .71 | 1.82 | 2.76 | .44 | .46 |
| ¾ | 1.05 | 14 | .15 | 1.40 | 1.69 | 1.23 | .98 | .82 | 2.21 | 3.19 | .50 | .53 |
| 1 | 1.32 | 11½ | .17 | 1.72 | 2.05 | 1.46 | 1.13 | .93 | 2.66 | 3.79 | .57 | .60 |
| 1¼ | 1.66 | 11½ | .19 | 2.10 | 2.48 | 1.73 | 1.32 | 1.07 | 3.23 | 4.55 | .63 | .67 |
| 1½ | 1.90 | 11½ | .20 | 2.36 | 2.80 | 1.94 | 1.47 | 1.18 | 3.65 | 5.12 | .75 | .74 |
| 2 | 2.38 | 11½ | .22 | 2.85 | 3.37 | 2.27 | 1.66 | 1.30 | 4.38 | 6.04 | .81 | .82 |
| 2½ | 2.88 | 8 | .24 | 3.44 | 3.98 | 2.61 | 1.89 | 1.46 | 5.17 | 7.06 | .94 | .91 |
| 3 | 3.50 | 8 | .26 | 4.14 | 4.72 | 3.01 | 2.14 | 1.61 | 6.14 | 8.25 | .97 | 1.00 |
| 3½ | 4.00 | 8 | .29 | 4.72 | 5.34 | 3.35 | 2.35 | 1.75 | 6.88 | 8.73 | 1.00 | 1.09 |
| 4 | 4.50 | 8 | .32 | 5.30 | 5.96 | 3.69 | 2.57 | 1.89 | 7.66 | 10.23 | 1.06 | 1.18 |
| 4½ | 5.00 | 8 | .35 | 5.88 | 6.58 | 4.03 | 2.78 | 2.03 | 8.44 | 11.22 | 1.13 | 1.27 |
| 5 | 5.56 | 8 | .38 | 6.52 | 7.26 | 4.40 | 3.01 | 2.18 | 9.29 | 12.30 | 1.19 | 1.36 |
| 6 | 6.63 | 8 | .42 | 7.66 | 8.44 | 5.02 | 3.37 | 2.37 | 10.85 | 14.22 | 1.31 | 1.45 |
| 7 | 7.63 | 8 | .46 | 8.74 | 9.56 | 5.62 | 3.72 | 2.57 | 12.31 | 16.03 | 1.44 | 1.54 |
| 8 | 8.63 | 8 | .50 | 9.82 | 10.68 | 6.22 | 4.07 | 2.77 | 13.71 | 17.84 | 1.56 | 1.63 |
| 9 | 9.69 | 8 | .54 | 10.96 | 11.86 | 6.85 | 4.44 | 2.98 | 15.32 | 19.96 | 1.63 | 1.72 |
| 10 | 10.75 | 8 | .58 | 12.11 | 13.05 | 7.48 | 4.79 | 3.18 | 16.85 | 21.64 | 1.69 | 1.81 |
| 11 | 11.75 | 8 | .63 | 13.19 | 14.17 | 8.08 | 5.14 | 3.38 | 18.31 | 23.45 | 1.75 | 1.90 |
| 12 | 12.75 | 8 | .68 | 14.27 | 15.29 | 8.69 | 5.50 | 3.59 | 19.78 | 25.28 | 1.81 | 2.00 |
| 14 | 14.00 | 8 | .74 | 15.58 | 16.66 | 9.49 | 5.99 | 3.89 | 21.66 | 27.65 | 1.94 | 2.10 |
| 15 | 15.00 | 8 | .80 | 16.66 | 17.78 | 10.10 | 6.35 | 4.10 | 23.15 | 29.50 | 2.06 | 2.20 |
| 16 | 16.00 | 8 | .86 | 17.74 | 18.90 | 10.70 | 6.70 | 4.30 | 24.60 | 31.30 | 2.19 | 2.30 |

NOTE.—14″, 15″, and 16″ pipe are named by their outside diameter. See columns A and B.

MACHINERY'S Data Sheet No. 45. Explanatory note: Page 7.

## CAST IRON FITTINGS—III

### DIMENSIONS OF CAST IRON FITTINGS FOR WROUGHT IRON PIPE.

**To withstand 200 pounds to the square inch.**

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⅛ | .41 | 27 | .14 | .71 | .95 | .76 | .66 | .59 | 1.17 | 1.82 | .38 | .31 |
| ¼ | .54 | 18 | .16 | .86 | 1.14 | .91 | .78 | .69 | 1.44 | 2.22 | .47 | .40 |
| ⅜ | .68 | 18 | .18 | 1.05 | 1.35 | 1.06 | .89 | .79 | 1.70 | 2.59 | .54 | .49 |
| ½ | .84 | 14 | .20 | 1.28 | 1.60 | 1.24 | 1.03 | .90 | 2.03 | 3.06 | .64 | .57 |
| ¾ | 1.05 | 14 | .22 | 1.54 | 1.93 | 1.44 | 1.18 | 1.02 | 2.42 | 3.66 | .70 | .66 |
| 1 | 1.32 | 11½ | .25 | 1.90 | 2.30 | 1.70 | 1.37 | 1.17 | 2.92 | 4.29 | .82 | .75 |
| 1¼ | 1.66 | 11½ | .28 | 2.29 | 2.77 | 1.99 | 1.58 | 1.33 | 3.51 | 5.09 | .87 | .84 |
| 1½ | 1.90 | 11½ | .30 | 2.56 | 3.11 | 2.17 | 1.70 | 1.41 | 3.90 | 5.60 | 1.00 | .91 |
| 2 | 2.38 | 11½ | .33 | 3.07 | 3.69 | 2.59 | 2.00 | 1.64 | 4.75 | 6.75 | 1.06 | 1.03 |
| 2½ | 2.88 | 8 | .36 | 3.68 | 4.31 | 2.96 | 2.24 | 1.81 | 5.55 | 7.79 | 1.31 | 1.14 |
| 3 | 3.50 | 8 | .39 | 4.30 | 5.04 | 3.33 | 2.46 | 1.93 | 6.46 | 8.92 | 1.34 | 1.25 |
| 3½ | 4.00 | 8 | .44 | 5.02 | 5.71 | 3.75 | 2.75 | 2.15 | 7.31 | 10.06 | 1.37 | 1.36 |
| 4 | 4.50 | 8 | .48 | 5.62 | 6.37 | 4.11 | 2.99 | 2.31 | 8.32 | 11.31 | 1.43 | 1.48 |
| 4½ | 5.00 | 8 | .53 | 6.24 | 7.03 | 4.49 | 3.24 | 2.49 | 8.94 | 12.18 | 1.50 | 1.59 |
| 5 | 5.56 | 8 | .57 | 6.80 | 7.76 | 4.85 | 3.46 | 2.63 | 9.77 | 12.63 | 1.56 | 1.70 |
| 6 | 6.63 | 8 | .63 | 8.08 | 8.98 | 5.53 | 3.89 | 2.89 | 11.33 | 15.22 | 1.68 | 1.81 |
| 7 | 7.63 | 8 | .69 | 9.20 | 10.14 | 6.16 | 4.25 | 3.10 | 12.89 | 17.14 | 1.81 | 1.93 |
| 8 | 8.63 | 8 | .75 | 10.32 | 11.30 | 6.80 | 4.64 | 3.34 | 14.89 | 19.03 | 1.93 | 2.04 |
| 9 | 9.69 | 8 | .81 | 11.40 | 12.52 | 7.41 | 4.99 | 3.53 | 15.91 | 20.90 | 2.00 | 2.15 |
| 10 | 10.75 | 8 | .87 | 12.69 | 13.78 | 8.13 | 5.44 | 3.83 | 17.55 | 22.99 | 2.06 | 2.26 |
| 11 | 11.75 | 8 | .95 | 13.35 | 14.98 | 8.78 | 5.84 | 4.08 | 19.20 | 25.04 | 2.12 | 2.38 |
| 12 | 12.75 | 8 | 1.03 | 14.95 | 16.18 | 9.42 | 6.23 | 4.32 | 20.68 | 26.91 | 2.18 | 2.50 |
| 14 | 14.00 | 8 | 1.11 | 16.32 | 17.63 | 10.28 | 6.78 | 4.68 | 22.51 | 29.29 | 2.31 | 2.62 |
| 15 | 15.00 | 8 | 1.20 | 17.46 | 18.83 | 10.94 | 7.19 | 4.94 | 24.05 | 31.24 | 2.43 | 2.75 |
| 16 | 16.00 | 8 | 1.29 | 18.60 | 20.04 | 11.58 | 7.58 | 5.18 | 25.54 | 33.12 | 2.63 | 2.88 |

NOTE.—14″, 15″, and 16″ pipe are named by their outside diameter. See columns A and B.

MACHINERY'S Data Sheet No. 45. Explanatory note: Page 7.

# CAST IRON FLANGES

| Size of Pipe, A | Diameter of Flange, N | | Thickness of Flange, P | | Thickness of Flange at Hub, Q | Diameter of Hub, O | Diameter of Bolt Circle S † | | Number of Bolts, R | | Diameter of Bolts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pressure less than 125 pounds | Pressure from 125 to 250 pounds | Pressure less than 125 pounds | Pressure from 125 to 250 pounds | Pressure less than 125 pounds* | Pressure less than 125 pounds* | Pressure less than 125 pounds | Pressure from 125 to 250 pounds | Pressure less than 125 pounds | Pressure from 125 to 250 pounds | Pressure less than 80 pounds | Pressure from 80 to 125 pounds | Pressure from 125 to 250 pounds |
| 2 | 6 | 6½ | ⅝ | ⅞ | 1 | 3¼ | 4¾ | 5 | 4 | 4 | ½ | ⅝ | ⅝ |
| 2½ | 7 | 7½ | 11/16 | 1 | 1⅛ | 3 13/16 | 5½ | 5⅞ | 4 | 4 | ½ | ⅝ | ¾ |
| 3 | 7½ | 8¼ | ¾ | 1⅛ | 1¼ | 4½ | 6 | 6⅝ | 4 | 8 | ½ | ⅝ | ⅝ |
| 3½ | 8½ | 9 | 13/16 | 1 3/16 | 1¼ | 5 | 7 | 7¼ | 4 | 8 | ½ | ⅝ | ⅝ |
| 4 | 9 | 10 | 15/16 | 1¼ | 1⅜ | 5⅝ | 7½ | 7⅞ | 4 | 8 | ⅝ | ¾ | ¾ |
| 4½ | 9¼ | 10½ | 15/15 | 1 5/16 | 1⅜ | 6 3/16 | 7¾ | 8½ | 8 | 8 | ⅝ | ¾ | ¾ |
| 5 | 10 | 11 | 15/16 | 1⅜ | 1½ | 6¾ | 8½ | 9¼ | 8 | 8 | ⅝ | ¾ | ¾ |
| 6 | 11 | 12½ | 1 | 1 7/16 | 1½ | 8 | 9½ | 10⅝ | 8 | 12 | ⅝ | ¾ | ¾ |
| 7 | 12½ | 14 | 1 1/16 | 1½ | 1½ | 9 | 10¾ | 11⅞ | 8 | 12 | ⅝ | ¾ | ⅞ |
| 8 | 13½ | 15 | 1⅛ | 1⅝ | 1¾ | 10⅛ | 11¾ | 13 | 8 | 12 | ⅝ | ¾ | ⅞ |
| 9 | 15 | 16 | 1⅛ | 1¾ | 1¾ | 11⅛ | 13¼ | 14 | 12 | 12 | ⅝ | ¾ | ⅞ |
| 10 | 16 | 17½ | 1 3/16 | 1⅞ | 2 | 12⅜ | 14¼ | 15¼ | 12 | 16 | ¾ | ⅞ | ⅞ |
| 12 | 19 | 20 | 1¼ | 2 | 2 | 14⅝ | 17 | 17¾ | 12 | 16 | ¾ | ⅞ | ⅞ |
| 14 | 21 | 22½ | 1⅜ | 2⅛ | 2 | 16 | 18¾ | 20 | 12 | 20 | ⅞ | 1 | ⅞ |
| 15 | 22¼ | 23½ | 1⅜ | 2 3/16 | 2 | 17⅛ | 20 | 21 | 16 | 20 | ⅞ | 1 | 1 |
| 16 | 23½ | 25 | 1 7/16 | 2¼ | 2¼ | 18 5/16 | 21¼ | 22½ | 16 | 20 | ⅞ | 1 | 1 |
| 18 | 25 | 27 | 1 9/16 | 2⅜ | No hub | No hub | 22¾ | 24½ | 16 | 24 | 1 | 1⅛ | 1 |
| 20 | 27½ | 29½ | 1 11/16 | 2½ | No hub | No hub | 25 | 26¾ | 20 | 24 | 1 | 1⅛ | 1⅛ |
| 22 | .... | 31½ | .... | 2⅝ | .... | .... | .... | 28¾ | .... | 28 | .... | .... | 1⅛ |
| 24 | .... | 34 | .... | 2¾ | .... | .... | .... | 31¼ | .... | 28 | .... | .... | 1⅛ |

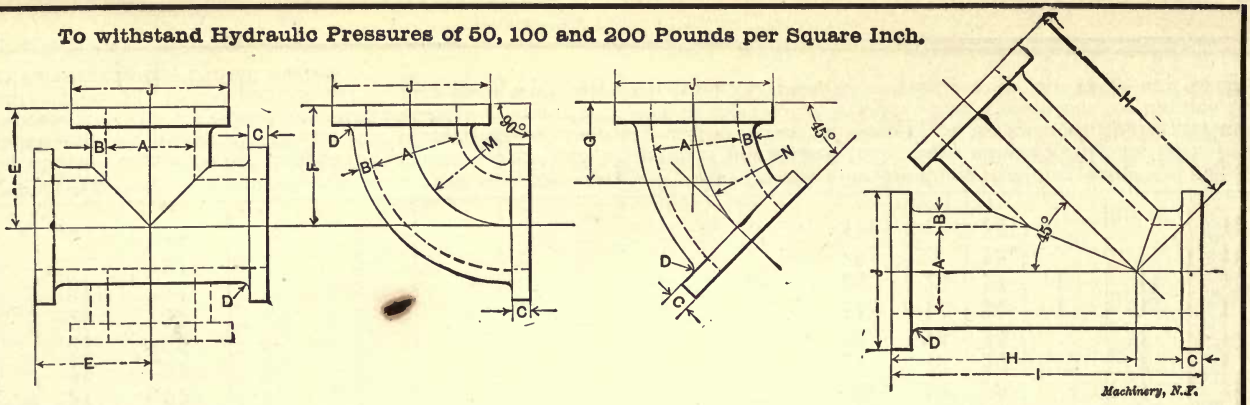
* Flanges for heavier pressures have no hub. † Bolt holes should not be drilled on the center line, but symmetrically on each side of it.

The above dimensions for flanges for pressures less than 125 pounds per square inch, were adopted July 18, 1894, by a Committee of the Master Steam and Hot Water Fitters' Association, the American Society of Mechanical Engineers, and the representatives of the leading valve and fitting manufacturers in the United States. The dimensions for flanges for pressures from 125 to 250 pounds per square inch were adopted June 28, 1901, at a meeting of the valve and fitting manufacturers in the United States.

Explanatory note: Page 7.

## DIMENSIONS OF CAST-IRON FLANGED FITTINGS

**To withstand Hydraulic Pressures of 50, 100 and 200 Pounds per Square Inch.**



Diameter of opening............ $A$

Thickness of pipe............... $B = \dfrac{A\text{ (pressure in lbs. per sq. inch)}}{3000} + .3125$ inch.

Thickness of flange............ $C = \dfrac{7B}{4}$ Radius of fillet.................. $D = \dfrac{C}{2}$ approximately

Center to face of flange, tee and cross......................... $E = \dfrac{J}{2} + 2C$, or next half-inch.

Center to face of flange; bends, up to 90°......................... $F$ and $G = \text{tang.} \left(\dfrac{\text{Ang}}{2}\right) \left(\dfrac{J}{2}\right) + 2C$, or next half-inch.

Center to face of flange, 45° Y.... $H = \text{tang. } 67\tfrac{1}{2}° \times \left(\dfrac{J}{2}\right) + 2C$, or next half-inch.

Face to face of flange, 45° Y..... $I = \text{tang. } 22\tfrac{1}{2}° \times \left(\dfrac{A}{2}\right) + 2C + H$, or next half-inch.

Diameter of flange...... ....... $J$ = standard. Number and size of bolts........ $K$ = standard.

Diameter of bolt circle.......... $L$ = standard.

Radius on center line of bends, up to 90°......................... $M$ and $N = \dfrac{\left(F \text{ or } G - \dfrac{3C}{2}\right)}{\left(\text{tang. } \dfrac{\text{Ang.}}{2}\right)}$. Use first quarter inch below.

MACHINERY's Data Sheet No. 43. Explanatory note: Page 7.

## DIMENSIONS OF CAST-IRON FLANGED FITTINGS, TO WITHSTAND 50 POUNDS TO THE SQUARE INCH.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | .25 | .62 | .25 | 4.5 | 4.5 | 2.5 | 8.5 | 10.5 | 6.00 | 4–½ | 4¾ | 3.25 | 7.75 |
| 2½ | .35 | .62 | .25 | 5.0 | 5.0 | 3.0 | 10.0 | 12.0 | 7.00 | 4–½ | 5½ | 3.75 | 9.00 |
| 3 | .25 | .63 | .25 | 5.5 | 5.5 | 3.0 | 10.5 | 12.5 | 7.50 | 4–½ | 6 | 4.00 | 9.75 |
| 3½ | .37 | .65 | .25 | 6.0 | 6.0 | 3.0 | 11.5 | 14.0 | 8.50 | 4–½ | 7 | 4.50 | 11.00 |
| 4 | .38 | .67 | .25 | 6.0 | 6.0 | 3.5 | 12.5 | 15.0 | 9.00 | 4–½ | 7½ | 4.75 | 11.50 |
| 4½ | .39 | .69 | .25 | 6.5 | 6.5 | 3.5 | 13.0 | 15.5 | 9.25 | 8–½ | 7¾ | 5.00 | 12.50 |
| 5 | .40 | .70 | .25 | 6.5 | 6.5 | 3.5 | 13.5 | 16.0 | 10.00 | 8–½ | 8½ | 5.25 | 12.75 |
| 6 | .41 | .71 | .25 | 7.0 | 7.0 | 4.0 | 15.0 | 18.0 | 11.00 | 8–½ | 9½ | 5.75 | 14.00 |
| 7 | .43 | .76 | .25 | 8.0 | 8.0 | 4.5 | 17.0 | 20.0 | 12.50 | 8–½ | 10¾ | 6.50 | 16.00 |
| 8 | .45 | .79 | .25 | 8.5 | 8.5 | 4.5 | 18.0 | 21.5 | 13.50 | 8–½ | 11¾ | 7.00 | 17.25 |
| 9 | .46 | .81 | .25 | 9.5 | 9.5 | 5.0 | 20.0 | 23.5 | 15.00 | 12–½ | 13¼ | 7.75 | 19.00 |
| 10 | .48 | .84 | .25 | 10.0 | 10.0 | 5.0 | 21.0 | 25.0 | 16.00 | 12–⅝ | 14¼ | 8.25 | 20.25 |
| 12 | .51 | .90 | .25 | 11.5 | 11.5 | 5.5 | 24.5 | 29.0 | 19.00 | 12–¾ | 17 | 9.75 | 24.00 |
| 14 | .55 | .97 | .32 | 12.5 | 12.5 | 6.0 | 27.0 | 32.0 | 21.00 | 12–¾ | 18¾ | 10.75 | 26.50 |
| 15 | .56 | .98 | .32 | 13.5 | 13.5 | 6.0 | 28.5 | 34.0 | 22.25 | 16–¾ | 20 | 11.50 | 28.00 |
| 16 | .58 | 1.02 | .32 | 14.0 | 14.0 | 7.0 | 30.5 | 36.0 | 23.50 | 16–¾ | 21¼ | 12.25 | 29.50 |
| 18 | .61 | 1.07 | .32 | 15.0 | 15.0 | 7.5 | 32.5 | 38.5 | 25.00 | 16–⅞ | 22¾ | 13.00 | 31.25 |
| 20 | .65 | 1.14 | .32 | 16.5 | 16.5 | 8.0 | 35.5 | 40.0 | 27.50 | 20–⅞ | 25 | 14.25 | 34.50 |
| 22 | .68 | 1.18 | .38 | 17.5 | 17.5 | 8.5 | 38.0 | 45.0 | 29.50 | 20–⅞ | 27¼ | 15.25 | 37.00 |
| 24 | .71 | 1.24 | .38 | 18.5 | 18.5 | 9.0 | 40.5 | 48.0 | 31.50 | 20–⅞ | 29½ | 17.25 | 41.75 |

MACHINERY'S Data Sheet No, 43. Explanatory note: Page 7.

## DIMENSIONS OF CAST-IRON FLANGED FITTINGS, TO WITHSTAND 100 POUNDS TO THE SQUARE INCH.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | .39 | .69 | .25 | 4.5 | 4.5 | 3.0 | 9.0 | 11.0 | 6.00 | 4– ½ | 4¾ | 3.25 | 8.00 |
| 2½ | .39 | .69 | .25 | 5.0 | 5.0 | 3.0 | 10.0 | 12.0 | 7.00 | 4– ½ | 5½ | 3.75 | 9.25 |
| 3 | .41 | .72 | .25 | 5.5 | 5.5 | 3.0 | 10.5 | 13.0 | 7.50 | 4– ½ | 6 | 4.00 | 9.75 |
| 3½ | .43 | .76 | .25 | 6.0 | 6.0 | 3.5 | 12.0 | 14.5 | 8.50 | 4– ½ | 7 | 4.50 | 11.00 |
| 4 | .45 | .79 | .25 | 6.5 | 6.5 | 3.5 | 12.5 | 15.0 | 9.00 | 4– ⅝ | 7½ | 4.75 | 11.75 |
| 4½ | .46 | .81 | .25 | 6.5 | 6.5 | 4.0 | 13.5 | 16.5 | 9.25 | 8– ⅝ | 7¾ | 5.25 | 12.75 |
| 5 | .48 | .84 | .25 | 7.0 | 7.0 | 4.0 | 14.0 | 17.0 | 10.00 | 8– ⅝ | 8½ | 5.25 | 13.00 |
| 6 | .51 | .90 | .25 | 7.5 | 7.5 | 4.5 | 15.5 | 19.0 | 11.00 | 8– ⅝ | 9½ | 5.75 | 14.25 |
| 7 | .55 | .97 | .32 | 8.5 | 8.5 | 5.0 | 17.5 | 21.0 | 12.50 | 8– ⅝ | 10¾ | 6.50 | 16.25 |
| 8 | .58 | 1.02 | .32 | 9.0 | 9.0 | 5.0 | 18.5 | 22.5 | 13.50 | 8– ⅝ | 11¾ | 7.25 | 17.50 |
| 9 | .61 | 1.07 | .32 | 10.0 | 10.0 | 5.5 | 20.5 | 24.5 | 15.00 | 12– ⅝ | 13¼ | 8.00 | 19.00 |
| 10 | .65 | 1.14 | .32 | 10.5 | 10.5 | 6.0 | 22.0 | 26.5 | 16.00 | 12– ¾ | 14¼ | 8.50 | 20.50 |
| 12 | .71 | 1.19 | .32 | 12.0 | 12.0 | 6.5 | 25.5 | 30.5 | 19.00 | 12– ⅞ | 17 | 10.00 | 24.25 |
| 14 | .78 | 1.37 | .38 | 13.5 | 13.5 | 7.5 | 28.5 | 34.5 | 21.00 | 12– ⅞ | 18¾ | 11.00 | 27.00 |
| 15 | .81 | 1.42 | .38 | 14.0 | 14.0 | 7.5 | 30.0 | 36.0 | 22.25 | 16– ⅞ | 20 | 11.75 | 28.50 |
| 16 | .85 | 1.49 | .38 | 15.0 | 15.0 | 8.0 | 31.5 | 38.0 | 23.50 | 16– ⅞ | 21¼ | 12.50 | 30.00 |
| 18 | .91 | 1.60 | .38 | 16.0 | 16.0 | 8.5 | 33.5 | 40.5 | 25.00 | 16–1 | 22¾ | 13.25 | 32.00 |
| 20 | .98 | 1.73 | .50 | 17.0 | 17.0 | 9.0 | 36.5 | 44.5 | 27.50 | 20–1 | 25 | 14.50 | 36.00 |
| 22 | 1.05 | 1.84 | .50 | 18.5 | 18.5 | 10.0 | 39.5 | 48.0 | 29.50 | 20–1 | 27¼ | 15.50 | 38.50 |
| 24 | 1.11 | 1.95 | .50 | 20.0 | 20.0 | 10.5 | 42.0 | 53.0 | 31.50 | 20–1 | 29½ | 16.50 | 40.25 |

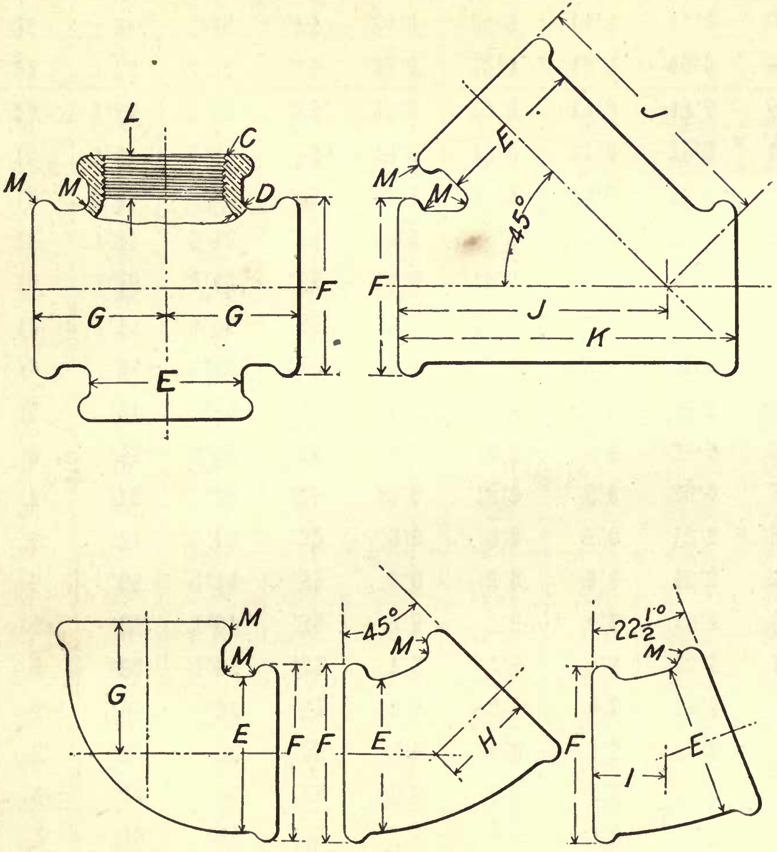
MACHINERY'S Data Sheet No. 43. Explanatory note: Page 7.

## DIMENSIONS OF CAST-IRON FLANGED FITTINGS, TO WITHSTAND 200 POUNDS TO THE SQUARE INCH.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | .46 | .81 | .25 | 5.0 | 5.0 | 3.0 | 9.5 | 12.0 | 6.50 | 4– ⅝ | 5 | 3.50 | 8.75 |
| 2½ | .48 | .84 | .25 | 5.5 | 5.5 | 3.5 | 11.0 | 13.5 | 7.50 | 4– ¾ | 5⅞ | 4.00 | 10.00 |
| 3 | .51 | .90 | .25 | 6.0 | 6.0 | 3.5 | 12.0 | 14.5 | 8.25 | 8– ⅝ | 6⅝ | 4.50 | 11.00 |
| 3½ | .55 | .97 | .32 | 6.5 | 6.5 | 4.0 | 13.0 | 15.5 | 9.00 | 8– ⅝ | 7¼ | 4.75 | 12.00 |
| 4 | .58 | 1.03 | .32 | 7.5 | 7.5 | 4.5 | 14.5 | 17.5 | 10.00 | 8– ¾ | 7⅞ | 5.50 | 13.25 |
| 4½ | .61 | 1.07 | .32 | 7.5 | 7.5 | 4.5 | 15.0 | 18.5 | 10.50 | 8– ¾ | 8½ | 5.75 | 13.75 |
| 5 | .65 | 1.14 | .32 | 8.0 | 8.0 | 5.0 | 16.0 | 19.5 | 11.00 | 8– ¾ | 9¼ | 6.00 | 14.50 |
| 6 | .71 | 1.25 | .32 | 9.0 | 9.0 | 5.0 | 17.5 | 21.5 | 12.50 | 12– ¾ | 10⅝ | 6.75 | 16.50 |
| 7 | .78 | 1.37 | .38 | 10.0 | 10.0 | 6.0 | 20.0 | 24.5 | 14.00 | 12– ⅞ | 11⅞ | 7.50 | 18.50 |
| 8 | .85 | 1.49 | .38 | 10.5 | 10.5 | 6.5 | 21.5 | 26.5 | 15.00 | 12– ⅞ | 13 | 8.25 | 19.75 |
| 9 | .91 | 1.59 | .38 | 11.5 | 11.5 | 6.5 | 22.5 | 28.0 | 16.00 | 12– ⅞ | 14 | 8.75 | 21.25 |
| 10 | .98 | 1.75 | .50 | 12.5 | 12.5 | 7.5 | 25.0 | 31.0 | 17.50 | 16– ⅞ | 15¼ | 9.50 | 23.25 |
| 12 | 1.11 | 1.95 | .50 | 14.0 | 14.0 | 8.5 | 28.5 | 35.0 | 20.00 | 16– ⅞ | 17¾ | 10.75 | 26.50 |
| 14 | 1.25 | 2.19 | .63 | 16.0 | 16.0 | 9.5 | 32.0 | 39.5 | 22.50 | 20– ⅞ | 20 | 12.25 | 29.75 |
| 15 | 1.31 | 2.30 | .63 | 16.5 | 16.5 | 10.0 | 33.5 | 41.5 | 23.50 | 20–1 | 21 | 12.75 | 31.00 |
| 16 | 1.38 | 2.42 | .63 | 17.5 | 17.5 | 10.5 | 35.0 | 44.0 | 25.00 | 20–1 | 22¼ | 13.50 | 33.00 |
| 18 | 1.51 | 2.64 | .75 | 19.0 | 19.0 | 11.0 | 38.0 | 47.0 | 27.00 | 24–1 | 24½ | 14.75 | 35.75 |
| 20 | 1.65 | 2.90 | .75 | 21.0 | 21.0 | 12.0 | 41.5 | 51.5 | 29.50 | 24–1⅛ | 26¾ | 16.00 | 39.00 |
| 22 | 1.78 | 3.06 | .75 | 22.0 | 22.0 | 13.0 | 44.5 | 55.5 | 31.50 | 28–1⅛ | 28¾ | 17.25 | 41.50 |
| 24 | 1.91 | 3.34 | .75 | 24.0 | 24.0 | 14.0 | 48.0 | 60.0 | 34.00 | 28–1⅛ | 31¼ | 18.50 | 45.00 |

MACHINERY'S Data Sheet No. 43. Explanatory note: Page 7.

# DIMENSIONS OF BRONZE FITTINGS—I



A = Size, or nominal inside diameter of wrought iron pipe.
B = Actual outside diameter of wrought iron pipe.
C = Number of threads to the inch.
D = Thickness of body of fitting.
E = Outside diameter of body of fitting
F = Diameter of end of fitting.
G = Center to face of Tee, Cross, and 90° Ell, or one-quarter bend.
H = Center to face of 45° Ell, or one-eighth bend.
I = Center to face of 22½° Ell, or one-sixteenth bend.
J = Center to face of 45° Y.
K = Face to face of 45° Y.
L = Length of threaded end.
M = Radius of Bead and all fillets

Note :- These fittings are long enough to admit of finishing the ends by turning

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## DIMENSIONS OF BRONZE FITTINGS—II

### FOR PRESSURES UP TO 70 LBS. TO THE SQ. IN.

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/8 | .41 | 27 | .06 | .53 | .70 | .58 | .54 | .47 | 1.05 | 1.42 | .20 | .09 |
| 1/4 | .54 | 18 | .08 | .70 | .87 | 71 | 63 | .54 | 1.30 | 1.77 | .24 | .09 |
| 3/8 | .68 | 18 | .09 | .86 | 1.03 | .84 | .72 | .62 | 1.55 | 2.09 | .30 | .09 |
| 1/2 | .84 | 14 | .09 | 1.02 | 1.21 | .96 | .84 | .71 | 1.82 | 2.40 | .33 | 10 |
| 3/4 | 1.05 | 14 | .10 | 1.25 | 1.46 | 1.18 | .98 | .82 | 2.19 | 2.99 | .38 | .11 |
| 1 | 1.32 | 11 1/2 | .11 | 1.54 | 1.77 | 1.39 | 1.13 | .93 | 2.65 | 3.58 | .44 | .12 |
| 1 1/4 | 1.66 | 11 1/2 | .13 | 1.92 | 2.17 | 1.62 | 1.32 | 1.07 | 3.25 | 4.31 | 50 | .13 |
| 1 1/2 | 1.90 | 11 1/2 | .14 | 2.18 | 2.45 | 1.89 | 1.47 | 1.18 | 3.68 | 4.95 | .56 | 14 |
| 2 | 2.38 | 11 1/2 | .16 | 2.70 | 2.99 | 2.16 | 1.66 | 1.30 | 4.48 | 5.96 | .63 | .15 |
| 2 1/2 | 2.88 | 8 | .17 | 3.22 | 3.52 | 2.50 | 1.89 | 1.46 | 5.28 | 6.97 | .75 | .16 |
| 3 | 3.50 | 8 | .19 | 3.88 | 4.22 | 2.92 | 2.14 | 1.61 | 6.33 | 8.20 | .79 | .18 |
| 3 1/2 | 4.00 | 8 | .20 | 4.40 | 4.78 | 3.23 | 2.35 | 1.75 | 7.27 | 9.19 | .83 | .20 |
| 4 | 4.50 | 8 | .22 | 4.94 | 5.35 | 3.57 | 2.57 | 1.89 | 8.03 | 10.25 | .87 | .22 |
| 4 1/2 | 5.00 | 8 | .25 | 5.50 | 5.97 | 3.95 | 2.78 | 2.03 | 8.95 | 11.23 | .91 | .25 |
| 5 | 5.56 | 8 | .28 | 6.12 | 6.65 | 4.36 | 3.01 | 2.18 | 9.98 | 12.57 | .95 | .28 |
| 6 | 6.63 | 8 | .31 | 7.25 | 7.85 | 5.00 | 3.37 | 2.37 | 11.78 | 14.73 | 1.00 | .32 |

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## DIMENSIONS OF BRONZE FITTINGS—III

### FOR PRESSURES UP TO 125 LBS. TO THE SQ. IN.

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/8 | .41 | 27 | .09 | .59 | .76 | .63 | .54 | .47 | 1.14 | 1.51 | .25 | .09 |
| 1/4 | .54 | 18 | .10 | .74 | .93 | .78 | .63 | .54 | 1.40 | 1.86 | .31 | .10 |
| 3/8 | .68 | 18 | .11 | .90 | 1.11 | .92 | .72 | .62 | 1.67 | 2.24 | .38 | .11 |
| 1/2 | .84 | 14 | .12 | 1.08 | 1.31 | 1.07 | .84 | .71 | 1.93 | 2.50 | .44 | .12 |
| 3/4 | 1.05 | 14 | .14 | 1.33 | 1.58 | 1.30 | .98 | .82 | 2.37 | 3.15 | .50 | .13 |
| 1 | 1.32 | 11 1/2 | .16 | 1.64 | 1.91 | 1.52 | 1.13 | .93 | 2.87 | 3.79 | .57 | .14 |
| 1 1/4 | 1.66 | 11 1/2 | .17 | 2.00 | 2.29 | 1.75 | 1.32 | 1.07 | 3.44 | 4.48 | .63 | .15 |
| 1 1/2 | 1.90 | 11 1/2 | .19 | 2.28 | 2.62 | 2.08 | 1.47 | 1.18 | 3.93 | 5.15 | .75 | .17 |
| 2 | 2.38 | 11 1/2 | .20 | 2.78 | 3.16 | 2.34 | 1.66 | 1.30 | 4.74 | 6.13 | .81 | .20 |
| 2 1/2 | 2.88 | 8 | .22 | 3.32 | 3.74 | 2.69 | 1.89 | 1.46 | 5.61 | 7.34 | .94 | .22 |
| 3 | 3.50 | 8 | .24 | 3.98 | 4.45 | 3.10 | 2.14 | 1.61 | 6.68 | 8.47 | .97 | .25 |
| 3 1/2 | 4.00 | 8 | .26 | 4.52 | 5.05 | 3.40 | 2.35 | 1.75 | 7.58 | 9.52 | 1.00 | .28 |
| 4 | 4.50 | 8 | .28 | 5.06 | 5.65 | 3.78 | 2.57 | 1.89 | 8.48 | 10.59 | 1.06 | .31 |
| 4 1/2 | 5.00 | 8 | .31 | 5.62 | 6.26 | 4.17 | 2.78 | 2.03 | 9.39 | 11.68 | 1.13 | .34 |
| 5 | 5.56 | 8 | .34 | 6.24 | 6.94 | 4.60 | 3.01 | 2.18 | 10.41 | 12.90 | 1.19 | .38 |
| 6 | 6.63 | 8 | .39 | 7.41 | 8.20 | 5.30 | 3.37 | 2.37 | 12.30 | 15.15 | 1.31 | .42 |

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## DIMENSIONS OF BRONZE FITTINGS—IV

### FOR PRESSURES UP TO 250 LBS. TO THE SQ. IN

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⅛ | .41 | 27 | .11 | .63 | .93 | .76 | .67 | .60 | 1.40 | 1.70 | .38 | .16 |
| ¼ | .54 | 18 | .13 | .80 | 1.14 | 94 | .79 | .70 | 1.71 | 2.09 | .47 | .18 |
| ⅜ | .68 | 18 | .15 | 98 | 1.36 | 1.08 | .88 | .78 | 2.04 | 2.52 | .54 | .20 |
| ½ | .84 | 14 | .17 | 1.18 | 1.60 | 1.27 | 1.04 | .91 | 2.40 | 2.88 | .64 | .22 |
| ¾ | 1.05 | 14 | .19 | 1.43 | 1.89 | 1.50 | 1.18 | 1.02 | 2.84 | 3.51 | .70 | .24 |
| 1 | 1.32 | 11½ | .21 | 1.74 | 2.24 | 1.77 | 1.38 | 1.18 | 3.36 | 4.15 | .82 | .26 |
| 1¼ | 1.66 | 11½ | .23 | 2.12 | 2.66 | 2.00 | 1.57 | 1.32 | 3.99 | 4.91 | .87 | .28 |
| 1½ | 1.90 | 11½ | .25 | 2,40 | 2.94 | 2.33 | 1.72 | 1.43 | 4.41 | 5.50 | 1.00 | .30 |
| 2 | 2.38 | 11½ | .27 | 2.92 | 3.55 | 2.59 | 1.91 | 1.55 | 5.33 | 6.59 | 1.06 | .33 |
| 2½ | 2.88 | 8 | .30 | 3.48 | 4.17 | 3.06 | 2.26 | 1.83 | 6.25 | 7.74 | 1.31 | .36 |
| 3 | 3.50 | 8 | .33 | 4.16 | 4.91 | 3.47 | 2.51 | 1.98 | 7.37 | 9.02 | 1.34 | .39 |
| 3½ | 4.00 | 8 | .36 | 4.72 | 5.52 | 3.77 | 2.72 | 2.12 | 8.28 | 10.63 | 1.37 | .42 |
| 4 | 4.50 | 8 | .40 | 5.30 | 6.20 | 4.13 | 2.94 | 2.26 | 9.30 | 11.25 | 1.43 | .47 |
| 4½ | 5.00 | 8 | .44 | 5.88 | 6.88 | 4.54 | 3.15 | 2.40 | 10.32 | 12.43 | 1.50 | .52 |
| 5 | 5.56 | 8 | .49 | 6.54 | 7.64 | 4.97 | 3.38 | 2.55 | 11.46 | 13.76 | 1.56 | .57 |
| 6 | 6.63 | 8 | .55 | 7.73 | 8.93 | 5.67 | 3.74 | 2.74 | 13.40 | 16.05 | 1.68 | .62 |

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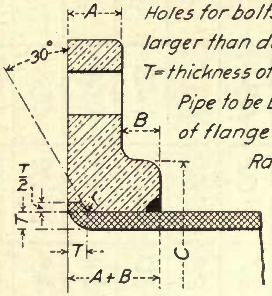
# COMPOSITION FLANGES FOR COPPER PIPE—I



*Holes for bolts to be drilled 1/16" larger than diameter of bolts.*
*T = thickness of pipe (as required).*
*Pipe to be beaded over at edge of flange a distance = T/2*
*Radius r = T/2*

*Pressures to 100 pounds per square inch*

| Internal Diam. of Pipe | Size of Flange: Diameter | Size of Flange: Thickness A | Size of Flange: Depth of Boss B | Size of Flange: A plus B | Size of Flange: Diameter of Boss C | Bolts: Number | Bolts: Diameter | Bolts: Diam. of Pitch Circle | Bolts: Pitch (Chord) |
|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 3 | 3/8 | 1/4 | 5/8 | 3/4 | 3 | 1/2 | 1 7/8 | 1.62 |
| 1/2 | 3 1/4 | 3/8 | 1/4 | 5/8 | 1 | 3 | 1/2 | 2 1/8 | 1.84 |
| 3/4 | 3 9/16 | 3/8 | 1/4 | 5/8 | 1 5/16 | 3 | 1/2 | 2 7/16 | 2.11 |
| 1 | 3 13/16 | 7/16 | 1/4 | 11/16 | 1 9/16 | 4 | 1/2 | 2 11/16 | 1.90 |
| 1 1/4 | 4 1/4 | 7/16 | 1/4 | 11/16 | 1 13/16 | 4 | 1/2 | 3 1/8 | 2.21 |
| 1 1/2 | 4 1/2 | 7/16 | 5/16 | 3/4 | 2 1/16 | 4 | 1/2 | 3 3/8 | 2.39 |
| 2 | 5 1/16 | 7/16 | 5/16 | 3/4 | 2 5/8 | 6 | 1/2 | 3 15/16 | 1.97 |
| 2 1/2 | 5 9/16 | 7/16 | 5/16 | 3/4 | 3 1/8 | 6 | 1/2 | 4 7/16 | 2.22 |
| 3 | 6 1/8 | 1/2 | 5/16 | 13/16 | 3 11/16 | 6 | 1/2 | 5 | 2.50 |
| 3 1/2 | 6 5/8 | 1/2 | 5/16 | 13/16 | 4 3/16 | 8 | 1/2 | 5 1/2 | 2.10 |
| 4 | 7 3/16 | 1/2 | 3/8 | 7/8 | 4 3/4 | 8 | 1/2 | 6 1/16 | 2.32 |
| 4 1/2 | 7 11/16 | 1/2 | 3/8 | 7/8 | 5 1/4 | 8 | 1/2 | 6 9/16 | 2.51 |
| 5 | 8 3/16 | 1/2 | 3/8 | 7/8 | 5 3/4 | 10 | 1/2 | 7 1/16 | 2.18 |
| 5 1/2 | 9 1/16 | 9/16 | 3/8 | 15/16 | 6 5/16 | 10 | 9/16 | 7 13/16 | 2.41 |
| 6 | 9 9/16 | 9/16 | 3/8 | 15/16 | 6 13/16 | 10 | 9/16 | 8 5/16 | 2.57 |
| 6 1/2 | 10 1/8 | 9/16 | 7/16 | 1 | 7 3/8 | 12 | 9/16 | 8 7/8 | 2.30 |
| 7 | 10 5/8 | 9/16 | 7/16 | 1 | 7 7/8 | 12 | 9/16 | 9 3/8 | 2.43 |
| 7 1/2 | 11 5/16 | 9/16 | 7/16 | 1 | 8 3/8 | 12 | 5/8 | 10 | 2.59 |
| 8 | 11 7/8 | 5/8 | 7/16 | 1 1/16 | 8 15/16 | 12 | 5/8 | 10 9/16 | 2.73 |
| 8 1/2 | 12 3/8 | 5/8 | 7/16 | 1 1/16 | 9 7/16 | 14 | 5/8 | 11 1/16 | 2.46 |
| 9 | 12 15/16 | 5/8 | 7/16 | 1 1/16 | 10 | 14 | 5/8 | 11 5/8 | 2.59 |
| 9 1/2 | 13 15/16 | 5/8 | 1/2 | 1 1/8 | 10 1/2 | 14 | 3/4 | 12 3/8 | 2.75 |
| 10 | 14 1/2 | 5/8 | 1/2 | 1 1/8 | 11 1/16 | 14 | 3/4 | 12 15/16 | 2.88 |
| 10 1/2 | 15 | 11/16 | 1/2 | 1 3/16 | 11 9/16 | 15 | 3/4 | 13 7/16 | 2.79 |
| 11 | 15 1/2 | 11/16 | 1/2 | 1 3/16 | 12 1/16 | 15 | 3/4 | 13 15/16 | 2.90 |
| 11 1/2 | 16 | 11/16 | 9/16 | 1 1/4 | 12 9/16 | 16 | 3/4 | 14 7/16 | 2.82 |
| 12 | 16 9/16 | 11/16 | 9/16 | 1 1/4 | 13 1/8 | 16 | 3/4 | 15 | 2.93 |
| 13 | 17 5/8 | 3/4 | 9/16 | 1 5/16 | 14 3/16 | 18 | 3/4 | 16 1/16 | 2.79 |
| 14 | 19 1/8 | 3/4 | 9/16 | 1 5/16 | 15 1/4 | 19 | 7/8 | 17 3/8 | 2.86 |
| 15 | 20 1/8 | 3/4 | 5/8 | 1 3/8 | 16 1/4 | 20 | 7/8 | 18 3/8 | 2.87 |
| 16 | 21 3/16 | 3/4 | 5/8 | 1 3/8 | 17 5/16 | 20 | 7/8 | 19 7/16 | 3.04 |
| 17 | 22 1/4 | 3/4 | 5/8 | 1 3/8 | 18 3/8 | 21 | 7/8 | 20 1/2 | 3.06 |
| 18 | 23 1/4 | 7/8 | 5/8 | 1 1/2 | 19 3/8 | 22 | 7/8 | 21 1/2 | 3.06 |
| 19 | 24 3/4 | 7/8 | 5/8 | 1 1/2 | 20 7/16 | 23 | 1 | 22 3/4 | 3.10 |
| 20 | 25 13/16 | 7/8 | 5/8 | 1 1/2 | 21 1/2 | 24 | 1 | 23 13/16 | 3.11 |
| 21 | 26 13/16 | 7/8 | 11/16 | 1 9/16 | 22 1/2 | 25 | 1 | 24 13/16 | 3.11 |
| 22 | 27 7/8 | 7/8 | 11/16 | 1 9/16 | 23 9/16 | 26 | 1 | 25 7/8 | 3.12 |
| 23 | 28 15/16 | 1 | 11/16 | 1 11/16 | 24 5/8 | 27 | 1 | 26 15/16 | 3.13 |
| 24 | 30 | 1 | 11/16 | 1 11/16 | 25 11/16 | 28 | 1 | 28 | 3.13 |
| 25 | 31 1/2 | 1 | 3/4 | 1 3/4 | 26 11/16 | 29 | 1 1/8 | 29 1/4 | 3.16 |
| 26 | 32 9/16 | 1 | 3/4 | 1 3/4 | 27 3/4 | 30 | 1 1/8 | 30 5/16 | 3.17 |
| 27 | 33 5/8 | 1 | 3/4 | 1 3/4 | 28 13/16 | 31 | 1 1/8 | 31 3/8 | 3.18 |
| 28 | 34 11/16 | 1 | 3/4 | 1 3/4 | 29 7/8 | 32 | 1 1/8 | 32 7/16 | 3.18 |
| 29 | 35 3/4 | 1 1/8 | 3/4 | 1 7/8 | 30 15/16 | 33 | 1 1/8 | 33 1/2 | 3.19 |
| 30 | 36 13/16 | 1 1/8 | 3/4 | 1 7/8 | 32 | 35 | 1 1/8 | 34 9/16 | 3.10 |

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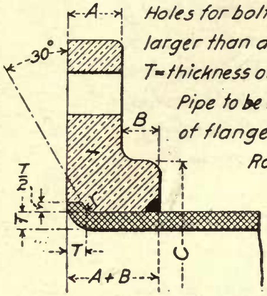
## COMPOSITION FLANGES FOR COPPER PIPE—II



Holes for bolts to be drilled 1/16" larger than diameter of bolts.
T = thickness of pipe (as required).
Pipe to be beaded over at edge of flange a distance = T/2
Radius r = T/2

Pressures from 101 to 300 pounds per sq. inch

| Internal Diam. of Pipe | Size of Flange | | | | | Bolts | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Diameter | Thickness A | Depth of Boss B | A plus B | Diameter of Boss C | Number | Diameter | Diam. of Pitch Circle | Pitch (Chord) |
| 1/4 | 3 7/16 | 9/16 | 3/16 | 3/4 | 15/16 | 3 | 1/2 | 2 5/16 | 2.00 |
| 1/2 | 3 3/4 | 5/8 | 3/16 | 13/16 | 1 3/16 | 3 | 1/2 | 2 5/8 | 2.27 |
| 3/4 | 4 | 5/8 | 3/16 | 13/16 | 1 1/2 | 4 | 1/2 | 2 7/8 | 2.03 |
| 1 | 4 5/16 | 11/16 | 3/16 | 7/8 | 1 3/4 | 4 | 1/2 | 3 3/16 | 2.25 |
| 1 1/4 | 5 1/16 | 11/16 | 3/16 | 7/8 | 2 1/16 | 5 | 5/8 | 3 3/4 | 2.20 |
| 1 1/2 | 5 3/8 | 11/16 | 3/16 | 7/8 | 2 5/16 | 5 | 5/8 | 4 1/16 | 2.39 |
| 2 | 5 15/16 | 3/4 | 3/16 | 15/16 | 2 7/8 | 6 | 5/8 | 4 5/8 | 2.31 |
| 2 1/2 | 6 1/2 | 3/4 | 3/16 | 15/16 | 3 7/16 | 7 | 5/8 | 5 3/16 | 2.25 |
| 3 | 7 9/16 | 13/16 | 3/16 | 1 | 4 | 8 | 3/4 | 6 | 2.30 |
| 3 1/2 | 8 1/8 | 13/16 | 1/4 | 1 1/16 | 4 9/16 | 8 | 3/4 | 6 9/16 | 2.51 |
| 4 | 8 11/16 | 7/8 | 1/4 | 1 1/8 | 5 5/8 | 9 | 3/4 | 7 1/8 | 2.44 |
| 4 1/2 | 9 1/4 | 7/8 | 1/4 | 1 1/8 | 5 11/16 | 9 | 3/4 | 7 11/16 | 2.63 |
| 5 | 9 13/16 | 15/16 | 1/4 | 1 3/16 | 6 1/4 | 10 | 3/4 | 8 1/4 | 2.55 |
| 5 1/2 | 10 3/8 | 15/16 | 5/16 | 1 1/4 | 6 13/16 | 11 | 3/4 | 8 13/16 | 2.48 |
| 6 | 11 3/8 | 1 | 5/16 | 1 5/16 | 7 3/8 | 11 | 7/8 | 9 5/8 | 2.71 |
| 6 1/2 | 11 15/16 | 1 | 5/16 | 1 5/16 | 7 15/16 | 12 | 7/8 | 10 3/16 | 2.64 |
| 7 | 12 9/16 | 1 1/16 | 5/16 | 1 3/8 | 8 1/2 | 12 | 7/8 | 10 13/16 | 2.80 |
| 7 1/2 | 13 1/8 | 1 1/16 | 3/8 | 1 7/16 | 9 1/16 | 12 | 7/8 | 11 3/8 | 2.94 |
| 8 | 14 3/16 | 1 1/8 | 3/8 | 1 1/2 | 9 5/8 | 12 | 1 | 12 3/16 | 3.15 |
| 8 1/2 | 14 3/4 | 1 1/8 | 3/8 | 1 1/2 | 10 3/16 | 13 | 1 | 12 3/4 | 3.05 |
| 9 | 15 5/16 | 1 3/16 | 3/8 | 1 9/16 | 10 3/4 | 13 | 1 | 13 5/16 | 3.19 |
| 9 1/2 | 15 7/8 | 1 3/16 | 7/16 | 1 5/8 | 11 5/16 | 14 | 1 | 13 7/8 | 3.09 |
| 10 | 16 7/16 | 1 1/4 | 7/16 | 1 11/16 | 11 7/8 | 15 | 1 | 14 7/16 | 3.00 |
| 10 1/2 | 17 | 1 1/4 | 7/16 | 1 11/16 | 12 7/16 | 15 | 1 | 15 | 3.12 |
| 11 | 17 9/16 | 1 5/16 | 7/16 | 1 3/4 | 13 | 15 | 1 | 15 9/16 | 3.24 |
| 11 1/2 | 18 9/16 | 1 5/16 | 1/2 | 1 13/16 | 13 9/16 | 15 | 1 1/8 | 16 3/8 | 3.40 |
| 12 | 19 1/8 | 1 3/8 | 1/2 | 1 7/8 | 14 1/8 | 16 | 1 1/8 | 16 15/16 | 3.30 |
| 13 | 20 5/16 | 1 7/16 | 1/2 | 1 15/16 | 15 1/4 | 17 | 1 1/8 | 18 1/8 | 3.33 |
| 14 | 21 7/16 | 1 1/2 | 9/16 | 2 1/16 | 16 3/8 | 18 | 1 1/8 | 19 1/4 | 3.34 |
| 15 | 23 | 1 9/16 | 9/16 | 2 1/8 | 17 1/2 | 18 | 1 1/4 | 20 9/16 | 3.57 |

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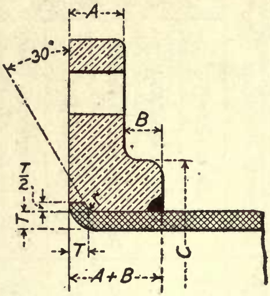
## COMPOSITION FLANGES FOR COPPER PIPE—III



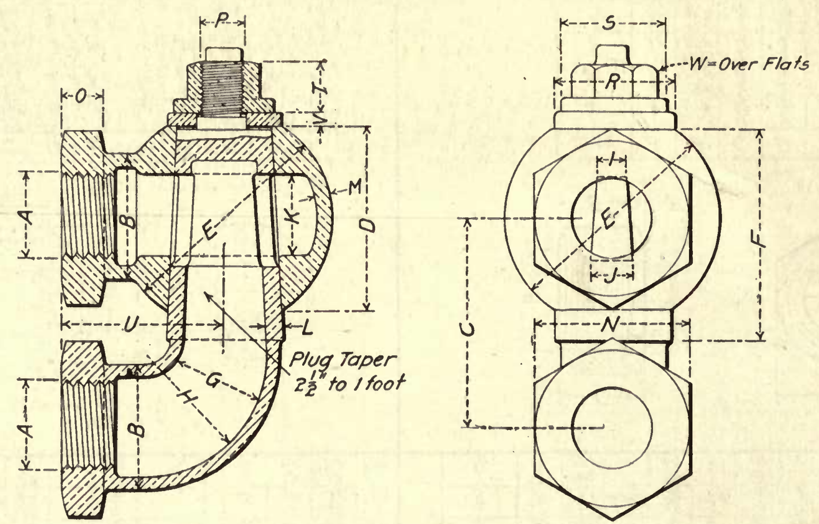
Holes for bolts to be drilled $\frac{1}{16}$" larger than diameter of bolts.
T = thickness of pipe (as required).
Pipe to be beaded over at edge of flange a distance = $\frac{T}{2}$
Radius $r = \frac{T}{2}$

Pressures from 301 to 500 pounds per square inch

| Internal Diam. of Pipe | Size of Flange | | | | | Bolts | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Diameter | Thickness A | Depth of Boss B | A plus B | Diameter of Boss C | Number | Diameter | Diam. of Pitch Circle | Pitch (Chord) |
| 1/4 | 3 9/16 | 5/8 | 3/16 | 13/16 | 15/16 | 3 | 1/2 | 2 7/16 | 2.11 |
| 1/2 | 3 13/16 | 11/16 | 3/16 | 7/8 | 1 1/4 | 4 | 1/2 | 2 11/16 | 1.90 |
| 3/4 | 4 5/8 | 3/4 | 3/16 | 15/16 | 1 9/16 | 4 | 5/8 | 3 5/16 | 2.34 |
| 1 | 4 7/8 | 3/4 | 3/16 | 15/16 | 1 13/16 | 5 | 5/8 | 3 9/16 | 2.09 |
| 1 1/4 | 5 3/16 | 13/16 | 3/16 | 1 | 2 1/8 | 5 | 5/8 | 3 7/8 | 2.28 |
| 1 1/2 | 5 1/2 | 13/16 | 1/4 | 1 1/16 | 2 7/16 | 6 | 5/8 | 4 3/16 | 2.09 |
| 2 | 6 5/8 | 7/8 | 1/4 | 1 1/8 | 3 | 6 | 3/4 | 5 1/16 | 2.53 |
| 2 1/2 | 7 3/16 | 7/8 | 5/16 | 1 3/16 | 3 5/8 | 7 | 3/4 | 5 5/8 | 2.44 |
| 3 | 7 13/16 | 15/16 | 5/16 | 1 1/4 | 4 1/4 | 8 | 3/4 | 6 1/4 | 2.39 |
| 3 1/2 | 8 7/16 | 1 | 5/16 | 1 5/16 | 4 13/16 | 9 | 3/4 | 6 7/8 | 2.35 |
| 4 | 9 7/16 | 1 | 3/8 | 1 3/8 | 5 7/16 | 9 | 7/8 | 7 11/16 | 2.63 |
| 4 1/2 | 10 1/16 | 1 1/16 | 3/8 | 1 7/16 | 6 | 9 | 7/8 | 8 5/16 | 2.84 |
| 5 | 11 1/8 | 1 1/8 | 3/8 | 1 1/2 | 6 5/8 | 9 | 1 | 9 1/8 | 3.12 |
| 5 1/2 | 11 3/4 | 1 1/8 | 7/16 | 1 9/16 | 7 1/4 | 10 | 1 | 9 3/4 | 3.01 |
| 6 | 12 3/4 | 1 3/16 | 7/16 | 1 5/8 | 7 13/16 | 10 | 1 1/8 | 10 9/16 | 3.26 |
| 6 1/2 | 13 3/8 | 1 1/4 | 7/16 | 1 11/16 | 8 7/16 | 10 | 1 1/8 | 11 3/16 | 3.46 |
| 7 | 13 15/16 | 1 1/4 | 1/2 | 1 3/4 | 9 1/16 | 11 | 1 1/8 | 11 3/4 | 3.31 |
| 7 1/2 | 14 9/16 | 1 5/16 | 1/2 | 1 13/16 | 9 5/8 | 11 | 1 1/8 | 12 3/8 | 3.49 |
| 8 | 15 5/8 | 1 3/8 | 1/2 | 1 7/8 | 10 1/4 | 11 | 1 1/4 | 13 3/16 | 3.72 |

Contributed by E. R. Bouvier. Explanatory note: Page 17.

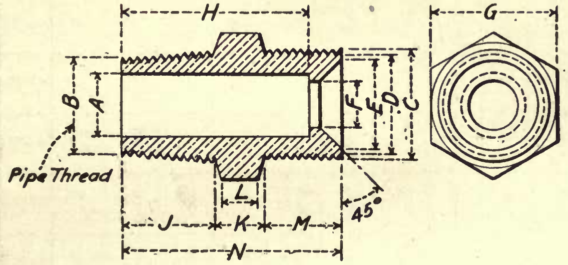
## SWING-JOINTS FOR LARGE ENGINE WATER SERVICE SYSTEMS



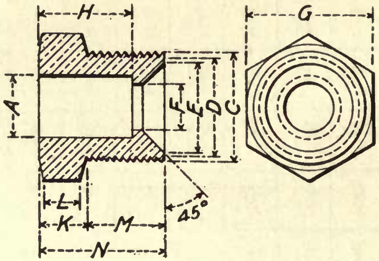
| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | R | S | T | U | V | W | Weight of Valve, Pounds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/8 Gas | 13/16 | 1 1/2 | 1 1/16 | 1 3/8 | 1 3/8 | 1/2 | 15/16 | 3/8 | 3/8 | 5/16 | 1/8 | 1/8 | 1 | 5/16 | 3/8 | 7/8 | — | 3/8 | 1 1/16 | 1/8 | 19/32 | 5/8 |
| 1/2 Gas | 1 1/8 | 1 3/4 | 1 5/16 | 1 5/8 | 1 9/16 | 3/4 | 1 1/8 | 5/16 | 3/8 | 7/16 | 3/16 | 1/8 | 1 1/4 | 3/8 | 3/8 | 1 1/16 | — | 15/32 | 1 5/16 | 5/32 | 11/16 | 7/8 |
| 3/4 Gas | 1 5/16 | 2 5/16 | 2 | 2 1/4 | 2 1/4 | 7/8 | 1 3/8 | 3/8 | 7/16 | 7/8 | 3/16 | 3/16 | 1 5/8 | 9/16 | 1/2 | 1 3/16 | 1 1/16 | 1/2 | 1 13/16 | 3/16 | 25/32 | 2 1/4 |
| 1 Gas | 1 11/16 | 2 1/2 | 2 1/8 | 2 9/16 | 2 1/2 | 1 | 1 3/4 | 7/16 | 1/2 | 1 1/16 | 1/4 | 3/16 | 1 13/16 | 9/16 | 5/8 | 1 7/16 | 1 3/16 | 19/32 | 2 1/4 | 7/32 | 7/8 | 3 1/8 |
| 1 1/4 Gas | 2 | 2 7/8 | 2 1/2 | 3 1/16 | 2 13/16 | 1 3/8 | 2 1/16 | 11/16 | 3/4 | 1 1/2 | 1/4 | 3/16 | 2 3/16 | 9/16 | 5/8 | 1 11/16 | 1 1/2 | 5/8 | 2 5/8 | 1/4 | 1 1/16 | 4 3/4 |

Contributed by W. S. Atkinson. Explanatory note: Page 17.

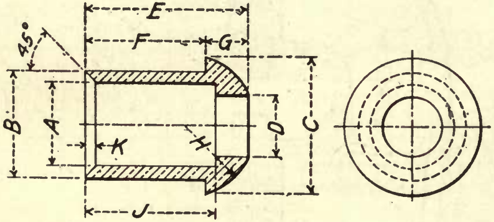
# BRAZING UNIONS



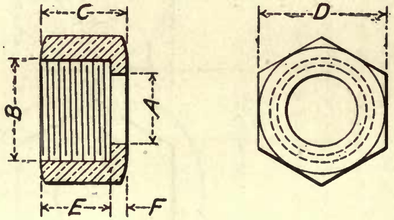
| Size | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 1/4 | 1/8 | 0.465<br>27P | 0.417 | 23/64 | 3/16 | 1/2 | 3/4 | 3/8 | 3/16 | 5/32 | 5/16 | 7/8 |
| 5/16 | 1/4 | 1/8 | 0.525<br>25P | 0.473 | 7/16 | | 9/16 | | 3/8 | 7/32 | 11/64 | 23/64 | 61/64 |
| 3/8 | 5/16 | 1/4 | 0.625<br>25P | 0.573 | 35/64 | | 11/16 | | 7/16 | 1/4 | 13/64 | 13/32 | 1 3/32 |
| 7/16 | 3/8 | 3/8 | 11/16<br>25P | | 39/64 | | 13/16 | | 9/16 | 1/4 | 13/64 | 13/32 | 1 3/32 |



| Size | A | C | D | E | F | G | H | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 1/4 | 0.465<br>27P | 0.417 | 23/64 | 3/16 | 1/2 | 3/8 | 3/16 | 5/32 | 5/16 | 1/2 |
| 5/16 | 5/16 | 0.525<br>25P | 0.473 | 7/16 | 1/4 | 9/16 | 7/16 | 7/32 | 11/64 | 23/64 | 37/64 |
| 3/8 | 3/8 | 0.625<br>25P | 0.573 | 35/64 | 5/16 | 11/16 | 1/2 | 1/4 | 13/64 | 13/32 | 21/32 |
| 7/16 | 7/16 | 11/16<br>25P | | 39/64 | 3/8 | 13/16 | 1/2 | 1/4 | 13/64 | 13/32 | 21/32 |



| Size | A | B | C | D | E | F | G | H | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | 1/4 | 5/16 | 25/64 | 3/16 | 15/32 | 11/32 | 1/8 | 13/64 | 3/8 | 1/32 |
| 5/16 | 5/16 | 3/8 | 29/64 | 1/4 | 35/64 | 13/32 | 9/64 | 1/4 | 7/16 | 1/32 |
| 3/8 | 3/8 | 15/32 | 35/64 | 5/16 | 41/64 | 15/32 | 11/64 | 5/16 | 1/2 | 3/64 |
| 7/16 | 7/16 | 17/32 | 39/64 | 3/8 | 41/64 | 15/32 | 11/64 | 11/32 | 1/2 | 3/64 |

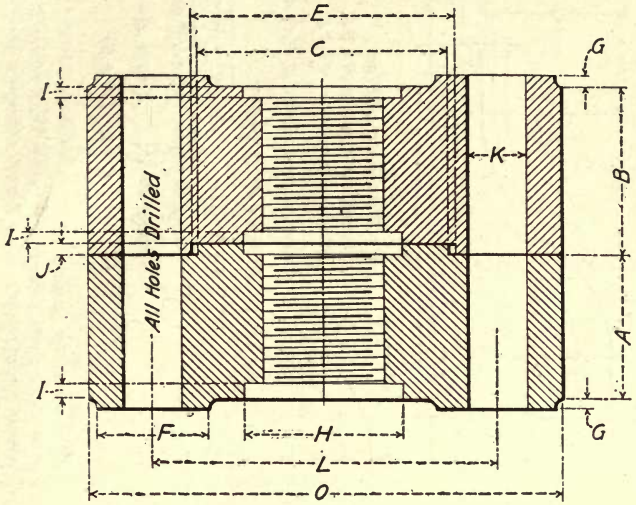


| Size | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1/4 | 5/16 | 0.465<br>27P | 11/32 | 9/16 | 9/32 | 1/16 |
| 5/16 | 3/8 | 0.525<br>25P | 3/8 | 5/8 | 5/16 | 1/16 |
| 3/8 | 15/32 | 0.625<br>25P | 7/16 | 3/4 | 23/64 | 5/64 |
| 7/16 | 17/32 | 11/16<br>25P | 7/16 | 13/16 | 23/64 | 5/64 |

Contributed by H. C. Snow. Explanatory note: Page 17.

## HYDRAULIC PIPE FLANGES

*Cast Iron – 550 pounds pressure.*



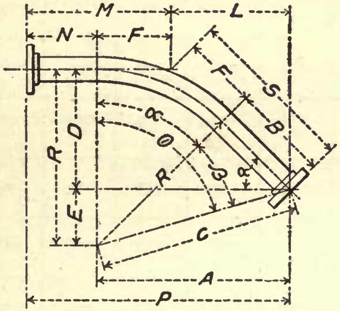
*D = diameter of pipe. M = diameter of bolt.*

| D | A | B | C | E | F | G | H | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 1/4 | 1 1/2 | 1 3/4 | 2 3/4 | 2 13/16 | No Pad | No Pad | 1 11/16 | 1/8 | 1/8 | 11/16 | 3 5/8 | 5/8 | 4 | 5 |
| 1 1/2 | 1 1/2 | 1 3/4 | 3 | 3 1/16 | No Pad | No Pad | 1 15/16 | 1/8 | 1/8 | 7/8 | 4 1/2 | 3/4 | 4 | 6 1/8 |
| 2 | 1 7/8 | 2 1/8 | 4 | 4 1/16 | 1 5/8 | 1/16 | 2 7/16 | 1/8 | 1/8 | 7/8 | 5 1/2 | 3/4 | 4 | 7 1/4 |
| 2 1/2 | 1 7/8 | 2 1/8 | 4 1/2 | 4 9/16 | 1 5/8 | 1/16 | 2 15/16 | 1/8 | 1/8 | 7/8 | 5 3/4 | 3/4 | 4 | 7 1/2 |
| 3 | 1 15/16 | 2 5/16 | 5 1/2 | 5 9/16 | 1 5/8 | 1/16 | 3 9/16 | 1/4 | 3/16 | 7/8 | 6 3/4 | 3/4 | 6 | 8 1/2 |
| 4 | 2 | 2 3/8 | 6 1/4 | 6 5/16 | 1 5/8 | 1/16 | 4 9/16 | 1/4 | 3/16 | 7/8 | 7 3/4 | 3/4 | 6 | 9 1/2 |
| 5 | 2 1/4 | 2 5/8 | 7 1/4 | 7 5/16 | 1 5/8 | 1/16 | 5 5/8 | 1/4 | 3/16 | 7/8 | 8 3/4 | 3/4 | 6 | 10 1/2 |
| 6 | 2 1/2 | 2 7/8 | 8 1/2 | 8 9/16 | 1 7/8 | 1/16 | 6 11/16 | 1/4 | 3/16 | 1 | 10 | 7/8 | 8 | 12 |

Contributed by W. J. Phillips. Explanatory note: Page 17.

# FORMULAS FOR PIPE BENDS—I

## Angle Bends. Given dimensions P, N, D, R.



$A = P - N;\quad E = R - D$

$C = \sqrt{E^2 + A^2}$ or

$C^2 = A^2 + E^2$

$B = \sqrt{C^2 - R^2}$

$\text{Cot. } \theta = \frac{E}{A}$ or

$\text{Tang. } \theta = \frac{A}{E}$

$\text{Cot. } \beta = \frac{R}{B}$ or $\text{Tang.} = \frac{B}{R}$

$\text{Angle } \alpha = \theta - \beta$

$F = R \times \text{Tang. } \frac{1}{2}\alpha$

$M = N + F;\quad L = A - F$

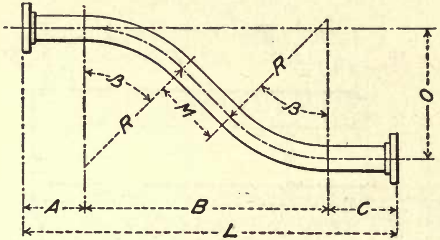
Given dimensions P, N, A, R, B.
$C^2 = B^2 + R^2;\ E = \sqrt{C^2 - A^2};\ D = R - E.$
$\text{Tang. } \theta = \frac{A}{E};\ \text{Tang. } \beta = \frac{B}{R};\ \alpha = \theta - \beta;\ F = R \times \text{Tang. } \frac{1}{2}\alpha;$
$M = N + F;\quad S = F + B;\quad L = A - F.$

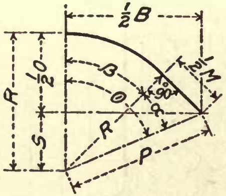
Given dimensions P, N, A, α, and R.
$F = R \times \text{Tang. } \frac{1}{2}\alpha.\quad L = A - F.\quad \text{Tang. } \alpha = \frac{D}{L}.\quad D = \text{Tang. } \alpha \times L.$
$S = \sqrt{L^2 + D^2}$ or $S = \frac{D}{\text{Sine } \alpha}.\quad B = S - F.$
$M = N + F.$ Dimensions β, θ, C, E not required.

Given dimensions P, N, A, D, and α; to find R, B, and F.
$L = \frac{D}{\text{Tang. } \alpha}.\quad F = A - L.\quad R = \frac{F}{\text{Tang. } \frac{1}{2}\alpha}.\quad B = \sqrt{A^2 - 2RD + D^2}.$

Standard radius $R$ = 6 pipe diameters.
Minimum radius $R$ = 3 pipe diameters.
N, or B, should not be less than 1 pipe diameter.
When $R$ = 3 diameters, use extra heavy pipe.
When $R$ = over 3 diameters, use full weight pipe.

## Offset Bend with Straight Between Arcs.





D = Diameter of pipe.
Standard radius $R = 6D$.
Minimum radius $R = 3D$.

Given dimensions L, R, O, A, M.

To find β, B, and C.

$S = R - \frac{1}{2}O\qquad P = \sqrt{R^2 + (\frac{1}{2}M)^2}$

$\text{Tang. } \alpha = \frac{\frac{1}{2}M}{R}.\qquad \frac{1}{2}B = \sqrt{P^2 - S^2}$

$\text{Tang. } \theta = \frac{\frac{1}{2}B}{S}.\qquad \text{Angle } \beta = \theta - \alpha$

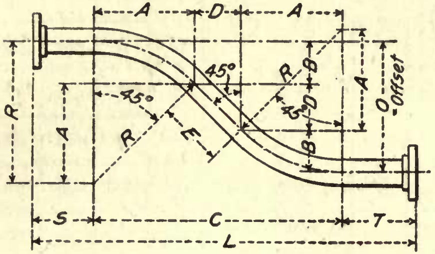
$C = L - (A + B)$

M, is usually made 12".
A or C should never be made less than D when good bends with tight flanges are required.
When $R = 3D$, use extra heavy pipe.
When $R$ = over $3D$, use full weight pipe.

Contributed by Wm. F. Fischer, MACHINERY'S Data Sheet No. 88. Explanatory note: Page 17.

## FORMULAS FOR PIPE BENDS—II

### 45-Degree Offsets.
Given offset O, radius R, length L and S.



$A = R \times 0.707$

$B = R - A$

$D = O - 2B$

$E = D \times 1.414$

$C = 2A + D$

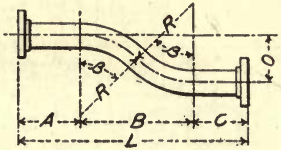
$T = L - (C + S)$

Length of each arc on center line equals $0.7854 \times$ rad. R.

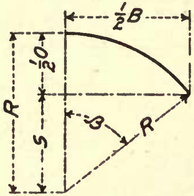
Note:-

Standard radius $R = 6 \times$ diam. of pipe.
Minimum radius $R = 3 \times$ diam. of pipe
S, or T, should not be less than $1 \times$ diam. of pipe.
When $R = 3 \times$ diam. of pipe, use extra heavy pipe.
When R is over $3 \times$ diam. of pipe, use full weight pipe.
When possible, keep S, or T, equal to at least $1\frac{1}{2} \times$ diam. of pipe or more, when screwed flanges are used.

### Offset Bend.
No straight between arcs.



D = Diameter of pipe
Standard radius $R = 6D$.
Minimum radius $R = 3D$.



Dimensions given L, O, R, A.
To find β, B, C.

$S = R - \frac{1}{2}O$

$\frac{1}{2}B = \sqrt{R^2 - S^2}$. $B = 2 \times \frac{1}{2}B$.

Tangent $\beta = \frac{\frac{1}{2}B}{S}$.

$C = L - (A + B)$.

When it is necessary to keep L as short as possible, make A and C each equal to one diam. of pipe. (This should be the limit for good bends), and make radius $R = 3D$.

To find dimensions L, B, and angle β:

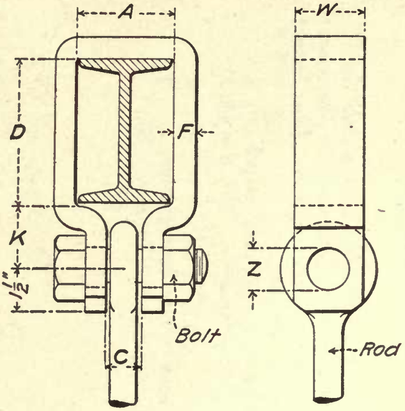
$S = R - \frac{1}{2}O$. $\frac{1}{2}B = \sqrt{R^2 - S^2}$ $B = 2 \times \frac{1}{2}B$.

Tang. $\beta = \frac{\frac{1}{2}B}{S}$ $L = A + B + C$.

When $R = 3D$, use extra heavy pipe.
When $R =$ over $3D$, use full weight pipe.

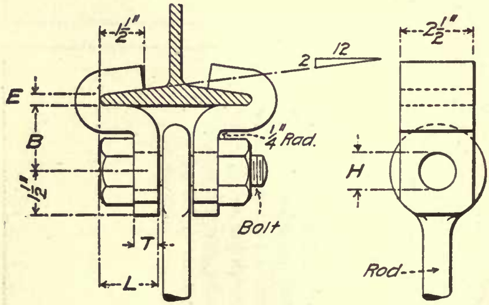
Contributed by Wm. F. Fischer, MACHINERY'S Data Sheet No. 88. Explanatory note: Page 17.

## PIPE CLAMPS AND HANGERS—I



| Size of Rod | C | Z | F | W | K | Size of Bolt |
|---|---|---|---|---|---|---|
| 3/4 | 7/8 | 1 | 1/2 | 2 | 1 5/8 | 7/8 x 3 1/4 |
| 7/8 | 1 | 1 1/8 | 5/8 | 2 1/4 | 1 7/8 | 1 x 3 3/4 |
| 1 | 1 1/8 | 1 1/4 | 3/4 | 2 1/2 | 2 1/8 | 1 1/8 x 4 1/4 |

| Size of Beam | A | D |
|---|---|---|
| 3 | 2 3/4 | 3 1/8 |
| 4 | 3 1/8 | 4 1/8 |
| 5 | 3 1/2 | 5 1/8 |
| 6 | 3 3/4 | 6 1/8 |
| 7 | 4 | 7 1/8 |



| Loads<br>Based on fibre stress of 12,000 pounds for wrought iron | |
|---|---|
| 3/4 Rod | 3500 |
| 7/8 Rod | 5000 |
| 1 Rod | 6500 |

All dimensions in inches
All loads in pounds

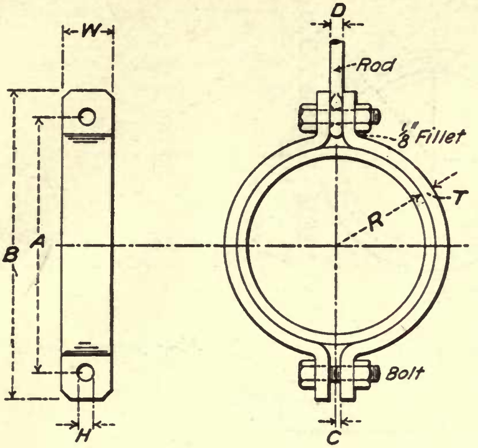
I Beam Clamps

| Size of Rod | T | B | H | Size of Bolt |
|---|---|---|---|---|
| 3/4 | 5/8 | 1 3/4 | 1 | 7/8 x 3 3/4 |
| 7/8 | 3/4 | 2 | 1 1/8 | 1 x 4 1/4 |
| 1 | 7/8 | 2 1/4 | 1 1/4 | 1 1/8 x 4 3/4 |

| Size of Rod | | Size of Beam | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8 | 9 | 10 | 12 | 15 | 18 | 20 | 24 |
| All Rods | E | 5/16 | 5/16 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 3/4 | L | 1 9/16 | 1 3/4 | 1 7/8 | 2 1/16 | 2 5/16 | 2 9/16 | 2 11/16 | 3 1/16 |
| 7/8 | L | 1 1/2 | 1 11/16 | 1 13/16 | 2 | 2 1/4 | 2 1/2 | 2 5/8 | 3 |
| 1 | L | 1 7/16 | 1 5/8 | 1 3/4 | 1 15/16 | 2 3/16 | 2 7/16 | 2 9/16 | 2 15/16 |

Contributed by L. S. Richardson, MACHINERY'S Data Sheet No. 80. Explanatory note: Page 44.

## PIPE CLAMPS AND HANGERS—II



Pipe Clamps Vertical Type.

All dimensions in inches

| For all Clamps | | | | | | |
|---|---|---|---|---|---|---|
| Size of Pipe | C | D | H | T | W | Size of Bolt |
| 4 | 1/2 | 3/4 | 1 | 3/8 | 1 3/4 | 7/8 x 3 |
| 4 1/2 | 1/2 | 3/4 | 1 | 3/8 | 1 3/4 | 7/8 x 3 |
| 5 | 1/2 | 3/4 | 1 | 3/8 | 2 | 7/8 x 3 |
| 6 | 1/2 | 3/4 | 1 | 3/8 | 2 | 7/8 x 3 |
| 7 | 1/2 | 3/4 | 1 | 3/8 | 2 | 7/8 x 3 |
| 8 | 9/16 | 7/8 | 1 1/8 | 7/16 | 2 | 1 x 3 1/2 |
| 9 | 9/16 | 7/8 | 1 1/8 | 7/16 | 2 1/4 | 1 x 3 1/2 |
| 10 | 9/16 | 7/8 | 1 1/8 | 7/16 | 2 1/4 | 1 x 3 1/2 |
| 12 | 5/8 | 1 | 1 1/4 | 1/2 | 2 1/2 | 1 1/8 x 4 |
| 14<br>15 O.D. | 5/8 | 1 | 1 1/4 | 1/2 | 2 1/2 | 1 1/8 x 4 |
| 15<br>16 O.D. | 5/8 | 1 | 1 1/4 | 1/2 | 2 1/2 | 1 1/8 x 4 |
| 16<br>17 O.D. | 5/8 | 1 | 1 1/4 | 1/2 | 2 1/2 | 1 1/8 x 4 |

| For Pipe Clamps | | | |
|---|---|---|---|
| Size of Pipe | A | B | R |
| 4 | 7 3/8 | 9 7/8 | 2 1/4 |
| 4 1/2 | 7 7/8 | 10 3/8 | 2 1/2 |
| 5 | 8 1/2 | 11 | 2 13/16 |
| 6 | 9 1/2 | 12 | 3 5/16 |
| 7 | 10 1/2 | 13 | 3 13/16 |
| 8 | 11 7/8 | 14 5/8 | 4 5/16 |
| 9 | 12 7/8 | 15 5/8 | 4 13/16 |
| 10 | 14 | 16 3/4 | 5 3/8 |
| 12 | 16 3/8 | 19 3/8 | 6 3/8 |
| 14<br>15 O.D. | 18 5/8 | 21 5/8 | 7 1/2 |
| 15<br>16 O.D. | 19 5/8 | 22 5/8 | 8 |
| 16<br>17 O.D. | 20 5/8 | 23 5/8 | 8 1/2 |

| For Fitting Clamps | | | |
|---|---|---|---|
| Size of Pipe | A | B | R |
| 4 | 8 5/8 | 11 1/8 | 2 7/8 |
| 4 1/2 | 9 1/8 | 11 5/8 | 3 1/8 |
| 5 | 9 5/8 | 12 1/8 | 3 3/8 |
| 6 | 10 3/4 | 13 1/4 | 3 15/16 |
| 7 | 11 3/4 | 14 1/4 | 4 7/16 |
| 8 | 13 1/4 | 16 | 5 |
| 9 | 14 1/4 | 17 | 5 1/2 |
| 10 | 15 3/8 | 18 1/8 | 6 1/16 |
| 12 | 18 1/8 | 21 1/8 | 7 1/4 |
| 14<br>15 O.D. | 20 3/8 | 23 3/8 | 8 3/8 |
| 15<br>16 O.D. | 21 1/2 | 24 1/2 | 8 15/16 |
| 16<br>17 O.D. | 22 5/8 | 25 5/8 | 9 1/2 |

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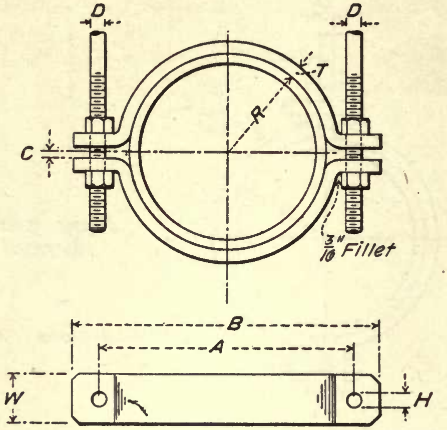
## PIPE CLAMPS AND HANGERS—III



Pipe Clamps
Horizontal Type

All dimensions in inches

For all Clamps

| Size of Pipe | C | D | H | T | W |
|---|---|---|---|---|---|
| 4 | 3/16 | 3/4 | 7/8 | 3/4 | 1 3/4 |
| 4 1/2 | 3/16 | 3/4 | 7/8 | 3/4 | 1 3/4 |
| 5 | 3/16 | 3/4 | 7/8 | 3/4 | 2 |
| 6 | 1/4 | 3/4 | 7/8 | 3/4 | 2 |
| 7 | 1/4 | 3/4 | 7/8 | 3/4 | 2 |
| 8 | 1/4 | 3/4 | 7/8 | 3/4 | 2 |
| 9 | 1/4 | 3/4 | 7/8 | 3/4 | 2 1/4 |
| 10 | 1/4 | 3/4 | 7/8 | 3/4 | 2 1/4 |
| 12 | 5/16 | 7/8 | 1 | 1 | 2 1/2 |
| 14<br>15 O.D. | 5/16 | 7/8 | 1 | 1 | 2 1/2 |
| 15<br>16 O.D. | 5/16 | 7/8 | 1 | 1 | 2 1/2 |
| 16<br>17 O.D. | 5/16 | 7/8 | 1 | 1 | 2 1/2 |

For Pipe Clamps

| Size of Pipe | A | B | R |
|---|---|---|---|
| 4 | 8 | 10 1/4 | 2 1/4 |
| 4 1/2 | 8 1/2 | 10 3/4 | 2 1/2 |
| 5 | 9 1/8 | 11 3/8 | 2 13/16 |
| 6 | 10 1/8 | 12 3/8 | 3 15/16 |
| 7 | 11 1/8 | 13 3/8 | 3 13/16 |
| 8 | 12 1/8 | 14 3/8 | 4 5/16 |
| 9 | 13 1/8 | 15 3/8 | 4 13/16 |
| 10 | 14 1/4 | 16 1/2 | 5 3/8 |
| 12 | 17 | 19 1/2 | 6 3/8 |
| 14<br>15 O.D. | 19 1/4 | 21 3/4 | 7 1/2 |
| 15<br>16 O.D. | 20 1/4 | 22 3/4 | 8 |
| 16<br>17 O.D. | 21 1/4 | 23 3/4 | 8 1/2 |

For Fitting Clamps

| Size of Pipe | A | B | R |
|---|---|---|---|
| 4 | 9 1/4 | 11 3/4 | 2 7/8 |
| 4 1/2 | 9 3/4 | 12 1/4 | 3 1/8 |
| 5 | 10 1/4 | 12 3/4 | 3 3/8 |
| 6 | 11 3/8 | 13 7/8 | 3 15/16 |
| 7 | 12 3/8 | 14 7/8 | 4 7/16 |
| 8 | 13 1/2 | 16 | 5 |
| 9 | 14 1/2 | 17 | 5 1/2 |
| 10 | 15 5/8 | 18 1/8 | 6 1/16 |
| 12 | 18 3/4 | 21 1/2 | 7 1/4 |
| 14<br>15 O.D. | 21 | 23 3/4 | 8 3/8 |
| 15<br>16 O.D. | 22 1/8 | 24 7/8 | 8 15/16 |
| 16<br>17 O.D. | 23 1/4 | 26 | 9 1/2 |

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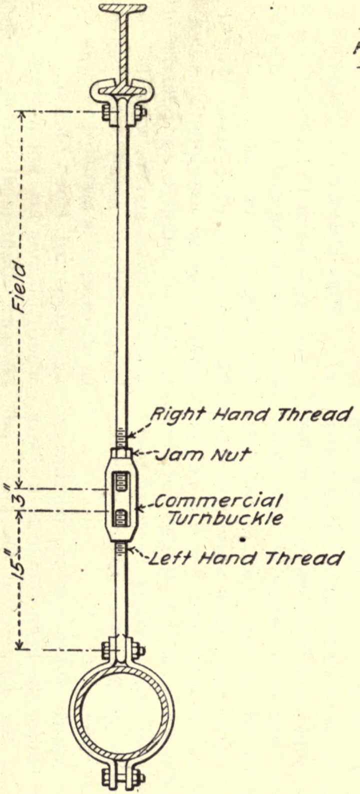
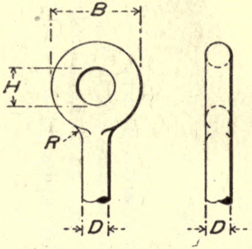
## PIPE CLAMPS AND HANGERS—IV

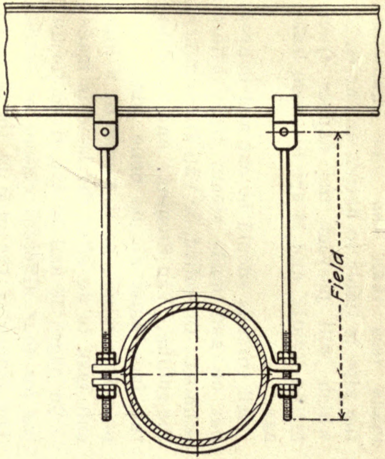


Vertical Type



Detail of Eye Bolt End

| Size of Rod (D) | B | H | R |
|---|---|---|---|
| 3/4 | 2 1/2 | 1 | 1 |
| 7/8 | 2 7/8 | 1 1/8 | 1 1/8 |
| 1 | 3 1/4 | 1 1/4 | 1 1/4 |



Horizontal Type

All dimensions in inches

The size of the rod is determined by the size of the pipe. See tables II and III.
The size of the beam clamp is determined by the size of the beam and the size of the rod. See table I.
For the vertical type make the lower rod 15 inches long with left hand thread. These can be made up in lots and be carried in stock.
Upper rod to have right hand thread and one jam nut.
Determine length of rod in field.
Use commercial turnbuckles.
Figure clearance between upper and lower rods as about 3 inches.
Rods are not upset at ends. Make threads 6 inches long.
Horizontal type rods to have 4 nuts each, right hand thread. Determine length of rod in field.

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by bending a round iron rod and carefully measuring it, until the right radius and dimensions are obtained. This templet is then placed over the center line of the pipe, as a guide in bending to shape.

As regards the kind of pipe to use, it should be of good quality standard steel or wrought iron pipe, full weight or extra heavy. Lap welded pipe should be used in preference to butt welded, as butt welded seam is liable to open up under the stress of bending. The welded joint should be placed directly over the center line of the pipe, along what might be called a neutral section, so that the joint will be neither in tension nor compression. This prevents the seam from being strained to any extent when bending.

Large pipe from 12 to 20 inches in diameter is liable to buckle on the compression side, especially if bent to a short radius. To prevent this, the radius when bending large sizes should be made as long as possible. A suitable radius for bending all sizes of pipe from 4 inches to 20 inches diameter, inclusive, is 6 times the diameter of the pipe, and this is known as "standard radius." Bends made with a radius having this proportion to the diameter of the pipe are very satisfactory. Pipe from 4 to 12 inches, however, can be bent, if necessary, to a radius equal to three times the diameter of the pipe, and sizes above 12 inches may be bent to a radius of four times the diameter of the pipe, if required. Even smaller radii than those last mentioned may be employed, but it is not advisable to do so, as it puts heavy strains on the pipe, and is likely to cause buckling on the compression side, even in the smaller sizes.

The length of the straight portion at either end of the bend should be at least equal to the diameter of the pipe, and in pipes 10 inches diameter and upward, it is advisable to make the smallest length of the straight portion equal to 1½ times the diameter of the pipe. If the length of the straight portion is made less than the pipe diameter, the pipe is liable to flatten on the ends, which will prevent the flanges from fitting tightly, and is apt to cause leakage.

All threads should be cut and flanges put on and made steam tight before bending. On rolled, or Van Stone joints, the rolling, "Van Stoning," and finishing the face must all be done while the pipe is straight, as it would be a difficult task to do after the bend is made.

On pages 38 and 39 are given formulas for four different classes of bends. The length of the pipe in the finished bend must be calculated to find out the length of straight pipe necessary. This length, of course, equals the length of the straight portions of the pipe added to the length of each of the arcs. The length of the arc is easily found from the formula:

$$L = \frac{3.1416}{180} \times R \times a$$

in which

$L$ = length of arc,

$R$ = radius,

$a$ = number of degrees in arc.

This formula, of course, will be found in this or similar form in all hand-books, and can be easily deducted by simple mathematics.

### Pipe Clamps and Hangers

On pages 40 to 43 inclusive are shown the construction and dimensions of several types of pipe clamps and hangers for supporting pipe lines. For the designer who is occasionally called upon to lay out hangers and clamps of this kind the types shown, with their dimensions, will be found very convenient. In all cases it is assumed that the clamps are supported from I-beams. In cases where I-beams are not available for the support, slight modifications of the supporting portion at the upper end will, of course, be necessary, but the other parts can be made to correspond to the design and sizes shown.

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